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NEW YORK, SATURDAY, MAY 12, 1900.

CONTENTS.

	Page
Editorial	689
New Independent Telephone Exchange in Cleveland	692
Plans of the Consolidated Street Railway and Lighting Companies of Kansas City	692
Regulations for Searchlights on the Suez Canal	692
Boston Elevated Train Equipment	692
Electric Lighting in New York City	692
The Jungfrau Three-Phase Electric Railway, by W. H. Molesworth	693
The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—VI., by J. E. Woodbridge	698
Special Apparatus for Testing Cables Rapidly and Accurately, by Henry W. Fisher, M.E.	701
The Properties of Carbon in Electrical Work—I., by Elihu Thomson	703
The Paris Exposition	705
The Johnson-Lundell Electric Traction Company, Ltd	706
Current News and Notes	706
LETTERS TO THE EDITORS:	
The Hannawa Falls Power Plant, by Chas. H. Lawrance	708
A. I. E. E. Election, by John J. Carty	708
Armature Reaction of Alternators, by B. A. Behrend	708
Digest of Electrical Literature, Compiled by Carl Hering	709
New Books	714
A New Closed Circuit Battery	714
Dry Cell for Testing Purposes	714
Opticians' Electromagnet	715
Electric Ignition for Gas Engines	715
A New Method for Filling Lubricators	715
NEWS OF THE WEEK:	
Financial Intelligence	716
Commercial Intelligence	717
Special Correspondence	718
General News	718
Obituary	722
Personal	722
Trade Notes	722
Record of Electrical Patents	723

FUTURE INTERNATIONAL EXPOSITIONS.

President Loubet put the utility of such an exposition as that now being held in Paris in one brief pregnant sentence, in his inaugural address, when he said that it was not to a mere holiday spectacle that he invited the nations, in the name of France, but a great school of instruction. Here lies the truth, for the man must, indeed, be blind to everything but gross pleasures who could pass even once through the Paris Exposition without receiving the impression of some fact in science, art and industry wholly new to his mind. And when we consider how many people go to an exposition to learn, to be informed, to study new methods, to make comparisons, it will be agreed that Mr. Loubet was right when he added that the results were not to be looked for in the decorative setting, but in the advances due to the peaceful competition of all peoples and governments. But the Paris Exposition also indicates that the day has passed when a world's fair can pretend to give on a natural scale a view of the larger developments of the industries, the hugeness of which implies corresponding hugeness in the associated apparatus and consequent impracticability of their use as exhibits.

It is, indeed, becoming a question whether exhibits of goods shall be massed where people can see them, or whether by travel those people shall go and see such things for themselves. So far as relates to lighter products, the Exposition idea still seems to hold good, but in the heavier branches, for example, of electrical and mechanical engineering, putting the apparatus into an exposition becomes less and less feasible. It thus arises that in America we have an endless stream of visitors from Europe to see our huge lighting and traction systems, our generators of 5000 horse-power, while at Paris it is literally impossible to set forth such work except by model and photograph. It is again here that the value of the technical press is appreciated and is enhanced by the data sent out broadcast about which little might otherwise become known. After all is said and done, with all the cheapness of modern travel, very few visitors from abroad can see for themselves the Brooklyn Bridge or the Metropolitan power plant, and the press has a growing responsibility in letting it be known and seen that such engineering work is possible on our shores, and that we stand prepared and willing to duplicate it anywhere on earth.

CABLE TESTING APPARATUS.

As soon as a number of electrical measurements have to be made in the regular course of routine and in a specified order and range, efforts are naturally made to systematize the work, partly for the purpose of avoiding mistakes, and partly to economize the time spent in preparation. We always find, therefore, that where a great number of tests have to be made in succession, the testing apparatus is advantageously mounted together in a co-operative manner and the operations are systematized in such a way that a testing set is evolved. On the other hand, the more the tests to be made vary, either in regard to range of measurement, or in regard to the nature of the measurement, the standardization of the apparatus and its reduction to a definite set is rendered more difficult and less advantageous.

Mr. Fischer's article in this number, on page 701, describes a set of cable-testing apparatus embodying insulation by direct reflec-

tion, electrostatic capacity by throw, and conductor resistance by Wheatstone bridge. The essential features appear to consist of a special switch, a sensitive horizontal galvanometer with a universal shunt, the whole supported in such a manner as to be exempt from disturbances due to vibration. None of these features taken by themselves can be regarded as novel, but it is in the details of such combinations that utility is to be looked for. The respective merits or demerits of cable-testing sets are never clearly apparent to the operator thereof, until the apparatus has been put into actual use for some time. Dozens of cable-testing sets have proved satisfactory, but several hundred have disappeared.

There can be no doubt that with the aid of a useful testing set the number of tests that can be successfully and carefully made in a given time is enormously increased, and not only without detriment to the accuracy of the work, but also with an actual increase of accuracy, because of the reduced number of operations in the successive changes of connections. The difficulties are apt to commence, however, when some unexpected conditions arise, requiring a variation in the routine, or when unexpected troubles occur within the testing set itself.

AN INTERESTING MOUNTAIN RAILWAY.

The electrical equipment of the Jungfrau Railway, an article upon which appears on the following pages, has many interesting points for electrical engineers in this country, where the use of polyphase motors for traction has not been tried commercially. It would seem that a mountain road, on account of the severe loads occasioned by its abnormal grades, would be a most difficult place for the use of polyphase motors. On the contrary, the work is almost ideal for such motors, because the speed demanded is uniform, the stops are few and the train service is infrequent, giving a small number of equipments with their special apparatus to be looked after. Locomotives are permissible, giving plenty of room for large motors and for the double-reduction gearing necessary to obtain the low speed of a mountain railway. The traction being obtained by means of a rack, no such weight is needed on the drivers as when frictional adhesion is depended upon. The motors are simply made large enough to give the needed starting torque with the aid of resistance in the secondary circuits.

Although no polyphase equipments of this kind have been built for traction purposes in this country, there is a generally defined idea that in the case of a long road with service so infrequent that the cost and attendance charges of rotary-converter sub-stations would be excessive per car mile, yet so situated with respect to water power and fuel supply that electric traction would be cheaper than steam, a complete polyphase equipment could be used and would prove electrically and commercially successful. On account of the probability of cases of this kind arising—in fact, such propositions are already under consideration—it is interesting to note some of the electrical peculiarities of the Jungfrau system.

In the first place, a frequency of 38 cycles per second is used, sufficient to give the induction motors, which have a speed of about 760 r. p. m., six poles, a more convenient number than four, which would be necessary with a materially lower frequency. Judging from previously published drawings of the locomotives, the motors have a diameter over all of about 4 ft., and a diameter at the air gap of about 27 ins. Their rotating secondaries are wound and connected to collector rings, by means of which they are connected in parallel with each other, the three-phase parallel circuits from the secondaries of the two motors being carried to a three-legged resistance, by which the starting current is kept down to a reasonable value. The parallel connection of the secondaries would appear to be of value in preventing one motor from exerting a materially greater torque than the other, or from slipping when the locomotive is starting on such sections of the road as are not fitted with racks. No attempt is made, or is necessary, to economize in starting current by the use of a tandem-multiple connection of the motors, or by means of compensators, or other devices, since the starts are infrequent and the power is generated at low cost. The illustrations also seem to indicate that the motors are ventilated and not enclosed, thus giving them a considerably greater capacity than they would have were they necessarily enclosed as are direct-current motors.

THE PROPERTIES OF CARBON IN ELECTRICAL WORK.

The first portion of an interesting paper by Prof. Elihu Thomson appears in this issue, upon the properties of carbon as utilized in the electrical arts. The more we learn about this wonderful substance, the more deeply we are impressed with its importance in all human affairs. We know that carbon enters into every organic structure, and in fact organic chemistry has been aptly termed the chemistry of carbon compounds. The average individual human being is a bank or trust fund for twenty pounds of this precious substance. He is constantly expending it at a slow rate for developing the energy required to maintain the human apparatus in working order, as well as for doing external work, and the stock has to be replenished several times a day.

Nearly all the carbon with which this earth was originally stocked must have found its way to the external surface of the incandescent mass in the early days, and it would seem that the atmosphere must originally have been principally composed of carbonic dioxide and nitrogen. By the slow labors of myriads of plants for millions of years, the atmospheric carbonic dioxide has been steadily reduced until the air only holds about one-twentieth of one per cent of this gas. That stock of carbon has been slowly assimilated by vegetable organisms into their own structure and also buried deep below the surface in their dead bodies in the forms of peat and coal. Animals and forest fires have tended to reverse the process and stop the robbing of carbon from the air, but the substance is still so comparatively precious in the organic world, that most of the atoms of carbon constituting each animal's structure must have been organized, disorganized and reorganized many times in the history of the past.

Prof. Thomson clearly points out that the physical properties of carbon are as special and as useful in the economy of the electrical arts, as the chemical properties of carbon are in the economy of the organic world. Among its chemical properties the most salient is perhaps its tetrad valency, and yet so great is its affinity for oxygen and so large the energy liberated in the union with oxygen, that carbon sometimes forgets its otherwise seemingly unbroken law of caste and tetrad nature, to combine with oxygen as a dyad under the form or carbonic oxide. Among its physical properties, the most salient is perhaps its low conductivity, relatively to metals, and yet in spite of this fact all our telephone circuits include carbon in their transmitters. All our lighting circuits include carbon in their incandescent and arc lamps, while even our direct-current power circuits commonly include carbon in the brushes of their dynamos and motors, so that in spite of the manifest inadaptability of carbon to electric conduction, we find it included in the majority of our conducting circuits.

It is a remarkable fact that a substance so eager to unite with the ever-present oxygen, judged by the energy yielded in the result, should require to be raised to so high a temperature in order to effect the combination. To this fact we owe, in a certain sense, our entire civilization, since without fire and without coal, man would

probably have been by this time still in the savage state. Its high boiling point of temperature is the keynote of its utility in the arc lamp; its high resistivity, combined with good lubrication, the secret of its use in the dynamo brush, and its high resistivity, high boiling temperature and mechanical rigidity the origin of its value in the incandescent lamp. Considering that carbon is known to us in three very different states—diamond, soot and graphite—its unalterability at high temperatures in the incandescent lamp is on a par with its other wonders. There is scarcely a commodity which is more valuable to electricians, either potentially or intrinsically. This is shown by the fact that if we should be justified in considering the price paid for the incandescent lamp as the cost of purchasing the small mass of carbon which it maintains in a vacuous space, the cost per pound of the filament would seem to be comparable with the cost of carbon in the diamond form.

THE LAY-OUT OF ROTARY-CONVERTER SUB-STATIONS.

The general arrangement of the boilers, engines, generators, switchboards, etc., of electric power stations has settled down to well-defined standard practice. In all cases where there are no peculiar local conditions to prevent it, the floor plan of a steam-electric power station shows a fire-room running down one side, all boilers facing it; behind the boilers appear the smoke flues, steam and exhaust headers, etc.; next comes the fire wall, on the other side of which are the engines, which, if horizontal, have their cylinder ends toward the wall; beyond them are the generators, and beyond them the switchboard. The apparatus is arranged with remarkable consistency in such a way that the power passes through the station in one direction in its consecutive transformations from latent energy of the coal to electric current. Taking a cross section through a typical power station there will be found on one side the coal bin, next to it the fire-room, and next to it the boilers, the steam piping continuing in the same direction to the engines, the mechanical power being transmitted in the same direction from the cylinders to the generators, the electrical power from them continuing in the same direction to the switchboard, and from it in the same direction to the outgoing feeders. Thus there is no material doubling of the power back over the course which it has already traversed, the steam pipes do not go back through the coal bins, nor do the electric conductors pass back alongside the steam pipes. More space is thus obtained for the conducting elements of each transformation, these elements being coal conveyors, steam pipes, or electric wires. In very large stations this gain is a highly important one, as in them the power confined in the conducting elements is so great that a breakdown in one element is likely to be so disastrous as to affect any other which may run in parallel with it over the same course. For instance, the breakdown of a large coal conveyor might wreck a neighboring steam pipe, or the bursting of a steam pipe would be likely to break down the insulation of adjacent high-tension wires.

The same general scheme of arranging the apparatus in the order in which the power passes through it has not as yet been adopted in rotary-converter sub-stations, but should be, owing to the size to which these stations are growing, the number and complexity of the conductors which they are coming to contain, and the amount of power behind them to cause disastrous spreading burn-outs in case of faults. It is customary to locate the various switchboard panels for the incoming lines, the high and low-tension sides of the transformers, the alternating and direct-current sides of the rotaries, and the outgoing feeders, either together in one switchboard or quite close to each other, the transformers, converters, blowers, etc., being grouped around them in any convenient way with high and low-tension alternating-current wiring, direct-current machine conductors and feeders and all small auxiliary wiring running criss-cross and higglety-pigglety under the floor. The plan appears a short-sighted one, certain to involve trouble in emergencies and to give no chance for consistently-arranged extensions or enlargements.

A far better arrangement than those common in the past is obtained by bringing in the high-tension polyphase feeders at one side of the sub-station, carrying out the direct-current feeders from the other side and locating the transforming and converting apparatus with its intermediate switchboards in such a way that the power continues through the sub-station in one general direction. With this purpose in mind the high-tension incoming-line panel will be located on that side of the sub-station through which the high-tension feeders enter; next toward the other side of the sub-station should come the high-tension transformer board, if such is used, then should follow the transformers themselves, their openings to receive the high-tension conductors being turned toward the high-tension side of the station. From the other side of the transformers the low-tension alternating conductors should proceed to the low-tension alternating-current board, if such is used, which should be located beyond the transformers in the general direction toward the outgoing side of the sub-station; beyond the low-tension alternating-current board should come the rotary converters and beyond them in the same direction should come the direct-current rotary and feeder switchboard, and beyond it the direct-current feeder pit. If this general direction is, let us say, from west to east, such a sub-station will allow enlargements of its capacity by extensions either to the north or south, or both, without confusion, the switchboards and rows of machines being simply extended in one or the other, or both, directions; just as a steam-electric power station of the usual type can be enlarged by extending its piping, switchboard and rows of boilers and engines in either or both directions.

This design divorces the direct and alternating-current switching apparatus of the rotaries, which apparatus is usually combined in one switchboard, one panel often serving alone to carry the direct and alternating-current switches and instruments of one converter. There is no particular need for this combination of the switch gear of both sides of one machine, since the two sets of switches need never be handled simultaneously, except perhaps when synchronizing and switching in a converter started from the direct-current end. The number of cables which must come up to one panel designed to handle both ends of the machine is more than can properly be crowded into the space usually granted. It is coming to be universal practice with one of the two large companies installing such equipments to put in a separate group of transformers for each rotary converter, the idea being in part to avoid the cross connection of the collector rings of the rotaries through alternating low-tension bus-bars, a cross connection which allows the interchange of direct currents, making the positive current of one machine very different from the negative current of the same machine, disturbing the commutation, increasing the heating losses, spoiling the indications of the direct-current instruments, etc. In this case there need be no switches in the leads between the transformers and the rotary, all switching of the alternating-current circuits to the rotaries being in the high-tension leads. In such a case pneumatically or magnetically-controlled switches and secondary instruments can be used on the alternating circuits and such alternating-current apparatus can easily be put on or near the direct-current board, since no heavy currents or high voltages are carried to the board. This is the case in the sub-stations of the Metropolitan Street Railway Company, a description of which appears in the section of the serial article on the polyphase equipment of this company's system on other pages of this paper.

Boston Elevated Train Equipment.

The financial newspapers some days ago printed a rumor to the effect that the Sprague Electric Company had been awarded the contract for the motor equipment of the Boston Elevated Railway. While this has not yet been officially confirmed, we learn that the elevated road executive committee has been instructed to place the contract with the Sprague Electric Company.

Electric Lighting in New York City.

On April 1 the Edison Company had connected on its system the equivalent of 1,155,262 16-cp lamps, including private plants using the company's services as an auxiliary, this service amounting to the equivalent of 102,029 16-cp lamps. The New York Gas, Heat, Light & Power Company, which now covers the Boroughs of Manhattan and the Bronx, had connected with its system on April 1 the equivalent of 1,375,826 16-cp lamps. This latter figure includes the Edison figures, but not the lamps connected on the circuits of the United Electric Light & Power Company, which amount to the equivalent of 250,000 16-cp lamps. The plants on the Brooklyn side of the East River will probably add to the above the equivalent of 500,000 16-cp lamps.

New Independent Telephone Exchange in Cleveland.

The new Electric Building and the exchanges of the Cuyahoga Telephone Company and the United States Telephone Company at Cleveland, Ohio, were opened for inspection on the evening of May 2, when a reception was tendered by the officials of the companies to the members and friends of the Associated Technical Clubs of Cleveland, of which the Electric Club is a part. Several hundred people were in attendance. During the evening Mr. Kempster B. Miller made an address on the telephone, closing with particular reference to the Kellogg divided exchange multiple switchboard in use in the new exchange. Mr. H. C. Critchfield, president of the Independent Telephone Association in Ohio, followed with a review of the independent movement and an outline of the aims of the United States Telephone Company. Thursday the building was inspected by the subscribers of the company and Friday by the general public.

The Plans of the Consolidated Street Railway and Lighting Companies of Kansas City.

All of the street railway properties of Kansas City are now merged in the Metropolitan Street Railway Company, and all of the central stations and franchises for lighting are owned by the Kansas City Electric Light Company. Both of these companies are largely Armour interests, and for both the consulting engineering firm of Pierce, Richardson & Neiler, of Chicago, is laying out an extensive new system of generation and distribution. The traction company now operates one large power station with low fuel and labor accounts in Kansas City, Kan., and seven other stations for cable or electric service or both, scattered in various parts of the city. The lighting company now operates three stations, one Edison and two high tension.

The present plan, the details of which have not been settled definitely, contemplates the construction of a polyphase power station for both services at a point on the Blue River, about four miles from the centre of the city, on the Missouri side. The new plant will be located on property already containing one of the old traction power houses. Power will be transmitted from this plant to four sub-stations, two for the lighting and two for the traction work. The large power station of the street railway company will be continued in service to carry the traction load on the Kansas side (as well as a part of that on the Missouri side). The cable lines, with the exception of one with excessive grades, will be equipped for electric traction. The lighting mains and feeders in the district now supplied with three-wire Edison current will be put underground, and the low-tension direct-current service will be continued by means of rotary converters in two sub-stations. Outside of this district, the incandescent lighting will be done by means of 60-cycle alternating current. It is not as yet definitely settled whether to make the whole generating system 60 cycle and supply both the railway and Edison systems by means of 60-cycle rotaries, or to generate 25 cycles for the rotary converters and use frequency changers or separate generators for the 60-cycle lighting. This point has been left undecided in the specifications, each manufacturing company being left at liberty to choose the system on which it can give the best prices, guarantees and so forth for the service intended, the conditions of this service being thoroughly described in the specifications by the consulting engineers, so that the bidders may use their own judgment to best effect.

In the underground district all commercial arc lighting will be carried on the three-wire direct-current mains. In the alternating-current districts the commercial arc lighting will also be on the constant-potential circuits, in this case alternating. All street lighting will be done by series enclosed arcs, supplied by four multi-circuit Brush machines, capable of carrying 150 enclosed lights each. These machines have already been ordered to displace the many small and wasteful arc machines of various types at present in use. The new arc machines will at first be belted to existing engines, but will later, in the contemplated system, be driven by direct-coupled synchronous motors.

A 200-kw, three-wire storage battery will be put in as soon as possible, to help out the overloaded Edison system for the next few months. To tide over next winter's load, four 200-kw, 125-volt rotaries, for which specifications are now out, will be installed, two being used as generators in one of the present stations and the other two as rotaries supplied from the first two via step-up and step-down transformers and a short transmission line. All of these rotaries will later be used in the regular way when the polyphase generating station is completed. The existing high-frequency, 1100-volt alternating-current lines will be re-equipped for 2200 volts and 60 cycles as rapidly as possible, and supplied temporarily from the 1100-volt machines by means of ordinary transformers with 2200-volt primaries tapped to serve temporarily in the stations as single-winding or auto-transformers, the secondaries being idle. Later these transformers will be used outside the stations on the system in the usual way. By these and similar ingenious expedients devised by the consulting engineers, Messrs. Pierce, Richardson & Neiler, the system will be gradually transformed from the old to the new without interfering with the service.

Regulations for Search Lights on the Suez Canal.

Before steamers intending to go through the Suez Canal at night can proceed, the agents of the company in Port Said or Port Thewfik (Suez) must be satisfied that they are provided as follows:

(1) With an electric searchlight or searchlights showing the channel 4000 ft. ahead, and so constructed as to admit of rapid splitting up of the beam of rays into two separate segments with a dark sector in the middle. (2) With electric lights sufficiently powerful to light up a circular area of about 700 ft. in diameter around the ship.

The agents of the company will decide whether the apparatus fulfils the requirements of the regulations, so that ships provided with it may, without inconvenience, be authorized to navigate the canal at night. Night transit may, however, be suspended in case of failure or want of power in the lights.

Whenever a vessel navigating by night has made fast in a siding, or in the canal, her searchlight must be extinguished, as well as the other lights above stated, and her running lights. All ships navigating by night in the Large Bitter Lakes between the North and South Lights, must also extinguish their searchlights, as well as any ship coming into Port Said at night from the south when making the curve from the canal into the harbor.

Navigation by night time by steamers unprovided with electric light is only authorized under exceptional circumstances, the captain then accepting entire responsibility in writing for any delay, mishap or damages that may happen to his own ship, as well as for any similar accidents he may cause to other ships in transit or to the company's craft and plant happening to be in the canal. Ships navigating under these conditions remain subject to all other rules regarding night transit.

The agents of a steamer at Port Said or Suez place the apparatus on board in charge of two men. The set consists of an engine and dynamo, the former being fed with the steam from the power piping. Wires run from the dynamo to the bow of the ship, and suspended over the bow is a structure containing the searchlight, in which a man stays all night to operate the searchlight.

The Jungfrau Three-Phase Electric Railway.

By W. H. Molesworth.

MOST people who have traveled in Switzerland consider Interlaken and its vicinity among the most beautiful districts of that country. Towering up at the back of Interlaken and prominent among the heights of the Berner Oberland is the Jungfrau, 13,667 ft. above the sea level and 11,808 ft. above Interlaken. The Jungfrau, undoubtedly one of the most famous and popular mountains in the world, each year attracts great crowds, though the average tourist seldom gets closer than the Little Scheidegg, a village 4720 ft. above Interlaken.

Before 1811 we hear of no one having ever reached the summit of the Jungfrau, and during the following forty years we know of only five successful attempts being made. The perils en-

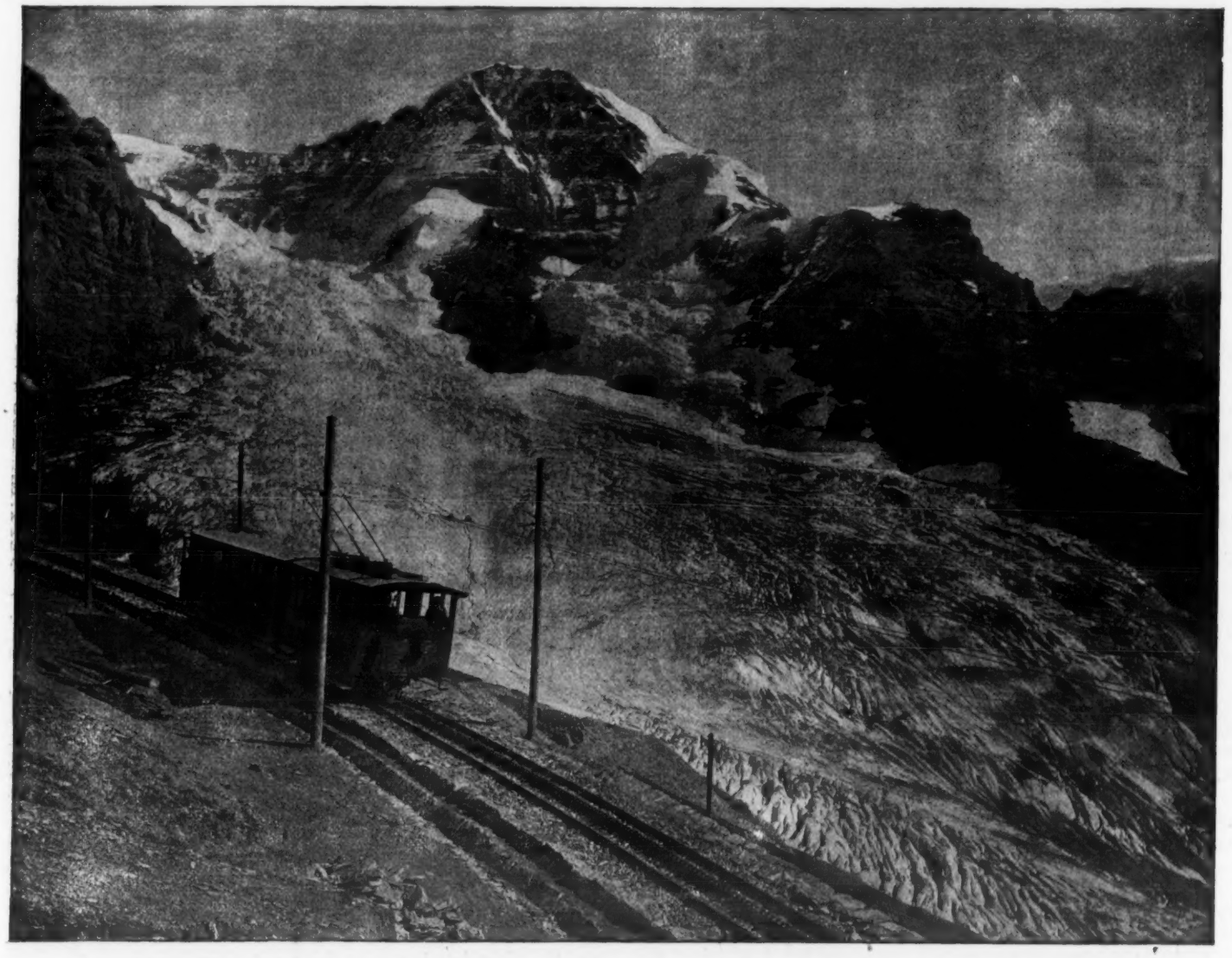


Fig. 1.—View on Jungfrau Electric Railway.

countered are considerable, and to enable visitors to enjoy the magnificent sight it offers without endangering their lives, many suggestions and proposals had been made, but it was not until 1890 that Guyer Zeller, of Zürich, brought forward a really workable scheme.

Professor Golliez, of Lausanne, was appointed to make a geological report on the line, and the dangers arising from air effects were studied by Prof. Kronecker, of Berne. After much labor, all opposition to the scheme was overcome and a concession was granted to Guyer Zeller in 1894 by the Swiss Federal Assembly. The unexpected death of Guyer Zeller in the spring of 1899 came as a great blow to the enterprise of which he had been the prime mover and energetic leader.

The scheme adopted was briefly this: A power station with turbines and three-phase alternators, to be erected below Lauterbrunnen; alternators to generate current at 7000 volts; bare wires to be employed for transmission at 7000 volts overhead in the open country, and concentric cables underground in the tunnel; transformer stations at intervals along the track, reducing the transmission voltage to that used for the locomotives; locomotives equipped with three-phase motors wound for 500 volts.

Water power is available from the Weisse Lütschine, which flows

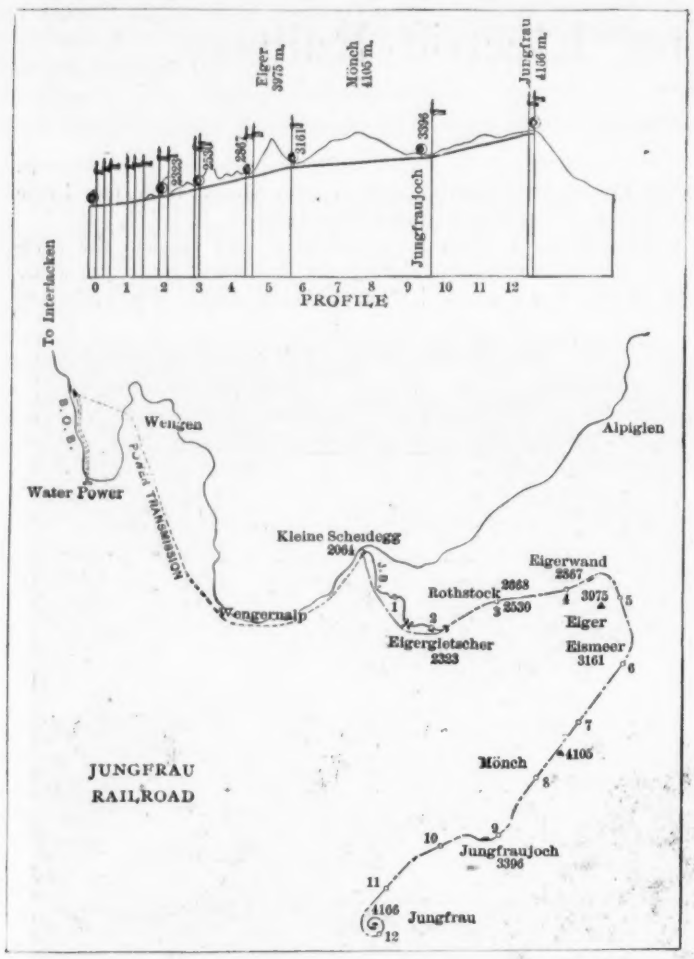


FIG. 2.—MAP AND PROFILE OF JUNGFRAU RAILWAY.

down the Valley of Lauterbrunnen, and from the Schwarze Lütschine, which drains the valley and the neighborhood of Grindelwald. These two rivers eventually meet and form the Lütschine, which deposits its waters in the lake of Brienz. As yet, the water of the Weisse Lütschine, with a minimum capacity of 2130 horse-power, has been sufficient for the heaviest demands, but in all probability a second power station on the Schwarze Lütschine will soon be necessary. The power of the Schwarze Lütschine is rated at above 9000 horse-power.

The Weisse Lütschine is dammed at a point just below Lauterbrunnen, and the water is carried in a metal pipe 6 ft. in diameter to the power station 5500 ft. further down the valley. The total fall is 130 ft., and at the entrance of the pipe are sluices, grated doors and an overflow. Turbines are already installed to the full capacity of the Weisse Lütschine, but about 30 per cent of the power is in reserve. There are two turbines of 800 horse-power, two of 500 horse-power and two of 25 porse-power, designed on the Girard system, with double wheel and horizontal shaft.

The four large units are connected to the main by a separate pipe; for the two small machines is one pipe which bifurcates before reaching the turbines. The reason for this is that the turbines of 25 horse-power are coupled to exciter dynamos, only one of which is in operation at any time. The four large turbines run at 380 r. p. m., and the small exciter turbines at 700 r. p. m., in all cases the turbine speed being automatically regulated.

The whole of the hydraulic work was carried out by Messrs. Rieter & Company and Messrs. Escher, Wyss & Company.

THE GENERATORS.

The generators, of which Fig. 3 is a type, are built to give three-phase currents at 7000 volts and 38 cycles. The two units of 800 horse-power and two of 500 horse-power are direct-coupled to their respective turbines by flexible insulating couplings, their bed-plates being mounted on porcelain insulators. The windings of these machines are stationary, being arranged on the inside of the armature. The armature coils are embedded in slots stamped out of the sheet iron which forms the magnetic path.

All coils are machine wound and interchangeable, and any coil can be removed from its slot and replaced within a few minutes without interfering with the rotor. The magnet coil is placed in the centre between the armature windings. The revolving portion consists of a metal wheel with laminated pole-pieces bolted upon the outer circumference, and is a purely mechanical structure. This type of machine is well adapted for high-tension work, as the coils can be exceptionally well insulated from each other and earth. There is an entire absence of slip rings and brushes. The load is chiefly traction, but some current is supplied to Lauterbrunnen and the immediate neighborhood for lighting purposes.

The two small direct-current dynamos have an output of 25 horse-power at 700 r. p. m. and 100 volts, and are direct-coupled to their turbines. Each machine is capable of exciting all four generators

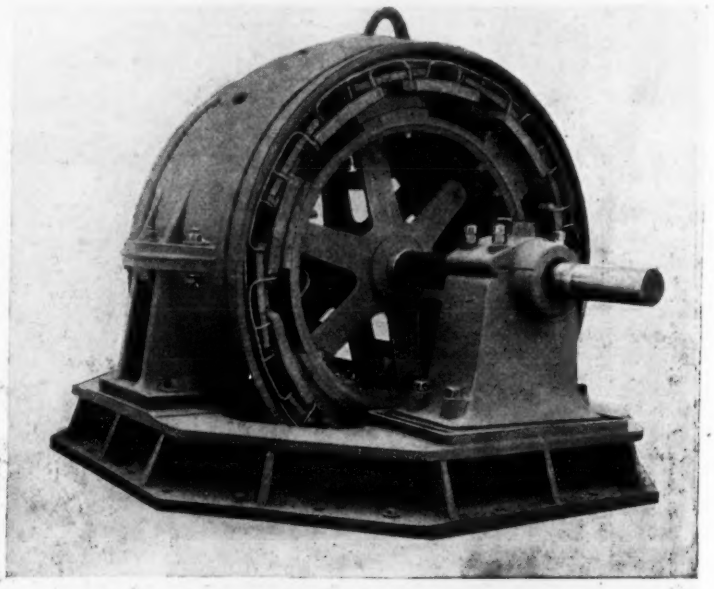


FIG. 3.—THREE-PHASE GENERATOR.

and supplying current for lighting the building. The switchboard contains the ordinary high-tension instruments and apparatus for this class of work.

THE HIGH-TENSION TRANSMISSION LINE.

The distance of the high-tension transmission line from the power station to the point where the tunnel commences is about six miles, and over this distance the three wires at 7000 volts are mounted on wooden poles. The dotted line in Fig. 2 marks the course of the high-tension wires over the six miles. The most striking feature of this part of the work is that the ground rises about one mile, and it will be easily imagined that on slippery rocks at a temperature below zero the work of erection was not altogether easy or pleasant. The diameter of each of the three wires is 7.5 mm.

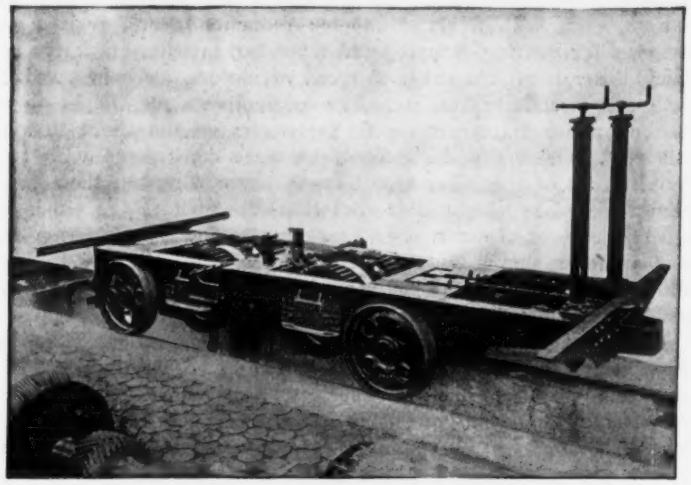
It was not thought advisable to use an overhead transmission beyond the Eigergletscher, so at the tunnel commences an underground transmission by triple concentric cable. The primary conductors for

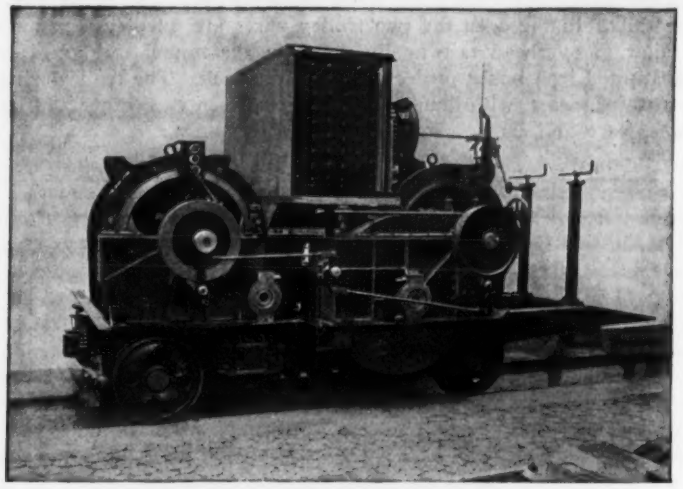
the whole distance are calculated for a maximum loss of 10 per cent.

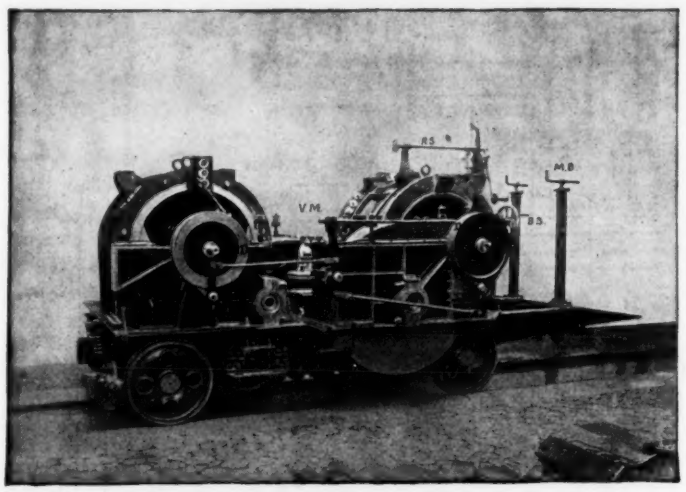
THE TRANSFORMER STATIONS.

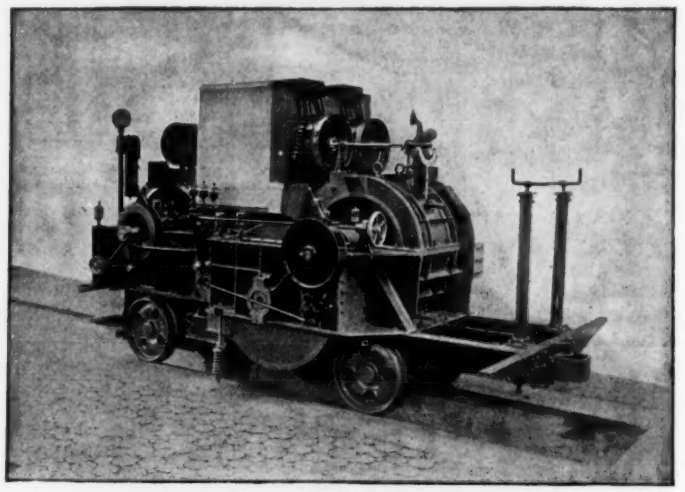
The transformer stations are built along the line, starting from Little Scheidegg, at intervals depending on the gradient of the track. In consideration of good working and economy it was determined to place transformer stations at every kilometer where the gradient is only current for the line and tunnel lighting is required. Here it will be noticed that a fourth wire is taken from the neutral point of the transformer secondary circuits for feeding the lamps in the tunnel. In all stations as well as at the power house great care was taken to procure the most effective lightning arresters possible.

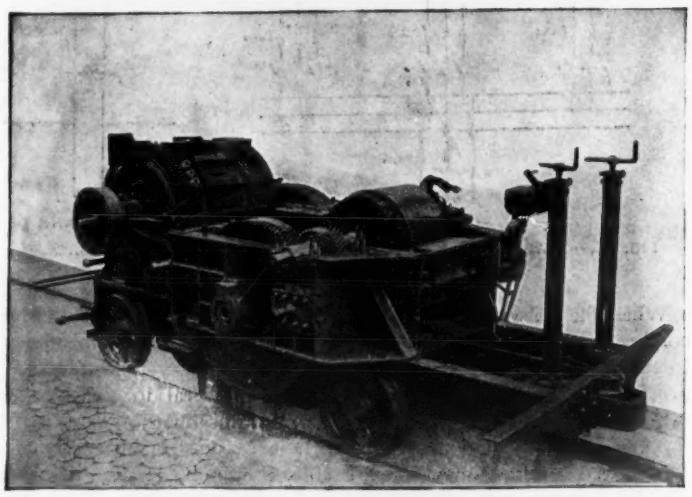
In the case of the more important stations such as Scheidegg, Eigerglacier, etc., where there are dwelling houses and restaurants,

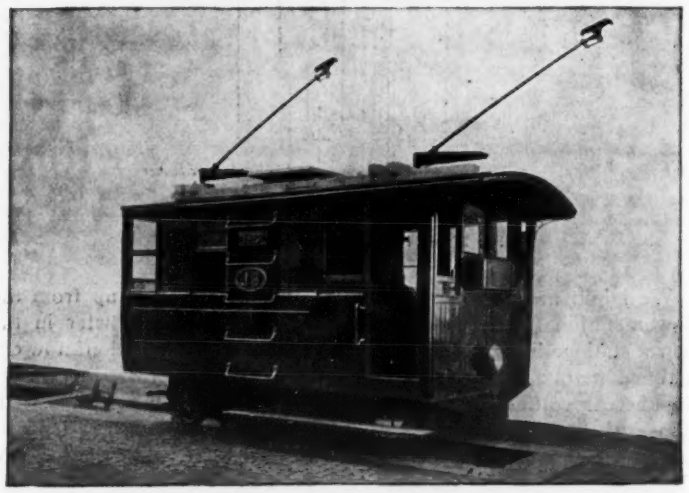












FIGS. 4 TO 9.—VIEWS OF LOCOMOTIVE IN VARIOUS STAGES OF ASSEMBLAGE.

25 per cent, and at about twice that interval when the gradient does not exceed 15 per cent. At each of these stations space for three transformers is allowed, besides room for the instruments, switches, etc. The transformers are from 180 to 200-kw output.

The transformers and all high-tension apparatus are carefully insulated from earth by porcelain or glass, this precaution being necessary on account of the severe lightning experienced in this district. The connections in Fig. 11 represent a typical sub-station where sub-stations are more elaborate, and besides the three transformers usually installed, is an additional transformer, a rotary converter and a battery of accumulators. These latter are to supply current and heat for buildings when the supply ceases, for feeding lamps in the tunnel, etc., in the event of a breakdown, or to enable workmen to make repairs during a stoppage. The capacity of this transformer is generally 40 kilowatts with a motor-generator of corresponding output. The size of the accumulator battery varies with

the size of stations or number of dwelling houses. Transformer stations are mostly cut out of the solid rock, and form an admirable protection from sudden climatic changes.

THE TROLLEY LINE.

The secondary or trolley line potential is 500 volts with a maximum drop of 12 per cent between any two sub-stations. The two conductors forming the trolley wires are 9 mm in diameter and of hard-drawn copper, the third phase being earthed and connected to the rails. In the open the two trolley wires are fixed in a manner similar to overhead railway lines, but in the tunnel for poles are substituted iron hooks projecting from the rock. The trolley wires are 16 ins. apart, with double insulation between each other and between each and earth.

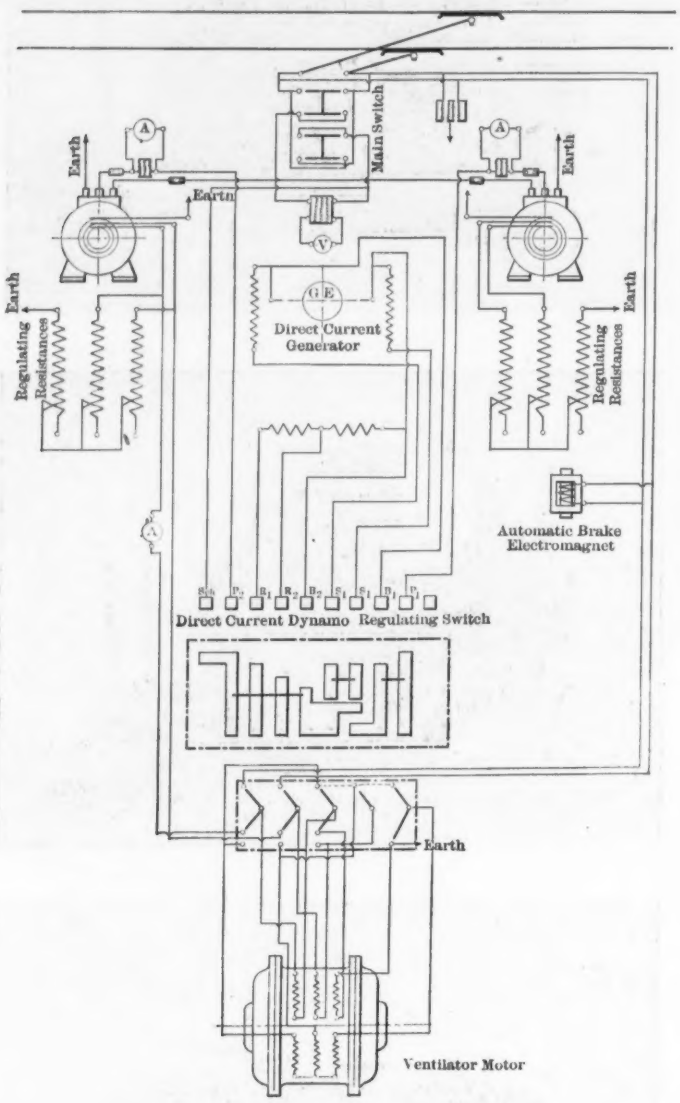


FIG. 10.—MOTOR-CAR CONNECTIONS.

We might mention here that there is a wire carried up from the power station to the trolley wires and back to a voltmeter in the power station. This is to let the engineers at the power station know exactly what voltage there is at the terminals of the motors. By watching the car voltmeter the motorman knows almost exactly his position in the tunnel, for as the drop midway between stations is at its maximum 12 per cent, the voltage will gradually rise as the locomotive approaches the next transformer station, and again fall slowly as the distance between a locomotive and a station increases. Should the voltage suddenly sink, the driver knows that another locomotive is on the same line, or that some part of the plant has become defective. The trolley wires are supported about every 100 ft.

The power station and all transformer stations are equipped with electrical machinery and apparatus from the Maschinenfabrik Oerlikon.

THE LOCOMOTIVES.

The locomotives have been ordered from Messrs. Brown, Boveri & Co., of Baden, and from the Maschinenfabrik Oerlikon. Although there is a difference in detail, all locomotives have been designed in compliance with certain given conditions, viz.: 500 volts, three-phase; a speed of five miles per hour; a periodicity of 38 cycles per second; a maximum rise of 25 per cent; a gauge of 3.28 ft.; a maximum weight of 16 tons; to draw two cars seating a total of 80 passengers.

The engravings on page 695 give several views of one of the most recently built locomotives, and it may be considered as a type of those hitherto designed. All locomotives possess two three-phase motors, each with a set of double reduction gears, resistances, switches for starting, stopping and reversing, instruments for measuring the voltage, current, and speed of motors, mechanical, magnetic and electric brakes, etc. The locomotive alone weighs 12 to 13 tons, and a train carrying 80 passengers weighs about 29 tons (metric). Originally the locomotives were constructed with two contact rods of the roller type to each phase wire, but these have been replaced by single slide contacts. The motors are either of 150 horse-power at 800 r. p. m. or 125 horse-power at 760 r. p. m., so that the minimum power on any locomotive is 250 horse-power. This value is normal, but the motors are capable of taking considerable overloads for short periods.

The weight is advantageous for this special work, as a lighter locomotive would have a tendency to jump and leave the rails. By mounting one end of one of the cars on an extension of the locomotive frame, the weight available for traction has been favorably increased. The cars so employed are supported at one end by the locomotive and at the other end by axle and wheels. To obtain the greatest benefit from this weight, cars are placed in front of the locomotive going up hill, and behind on going down.

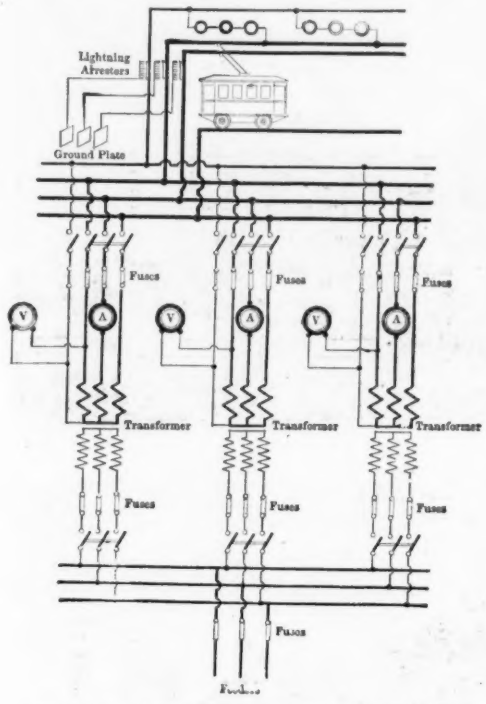


FIG. 11.—TRANSFORMER STATION CONNECTIONS.

FIG. 12.—ONE OF THE POLES.

When the railway is completed it is intended that the locomotives coming down shall pump current into the line and so supply power to those moving up. This has not been possible yet, however, for progress has not reached the stage when several locomotives are running at one time. To avoid severe strains on the generators it has been necessary to absorb the whole output generated by each locomotive coming down hill. In the first instance this was done by signaling to the power station at Lauterbrunnen on starting down to have a resistance switched into circuit, the ordinary motor starting resistances being insufficient for the purpose. Later locomotives have been provided with a resistance large enough to absorb the output of a locomotive. This resistance will be seen in one of the views mounted above the motors. The power wasted was practically of no consequence, because the water would pass the turbine house in any case. There are, however, two distinct advantages gained, namely, reduced wear and tear on the mechanical brakes and avoidance of injurious strains to which the generators and turbines would otherwise be subject.

The makers were still confronted by a somewhat formidable problem, namely, to provide some satisfactory means of reducing the speed of locomotives when coming down hill. The Maschinenfabrik Oerlikon are introducing on all their machines an innovation solving this difficulty which is worth a short description. The down-hill speed of the locomotives had always exceeded the up-hill speed, because it is a property of three-phase machinery, when working as generators, to run at a higher speed than when working as motors. By sending a direct current through the stator windings, the rotor, which revolves as soon as the locomotive starts down hill, generates a three-phase current. By means of a regulating resistance placed in circuit with the continuous current, the motor speed can be reduced as desired.

On each locomotive is a small direct-current dynamo run from the motor shaft with wires connected through a resistance to the terminals of the three-phase motors. The contact shoes are lowered from the overhead wires before starting and the dynamo geared in, so that a current from the dynamo flows through a resistance and the windings of the stator. The small current generated by the rotor is absorbed in the motor-starting resistance, and, by regulating the direct current, a low speed, say 50 per cent of the up-hill speed, can be maintained. Mechanical brakes are, of course, used on stopping, but by the method described much less wear is caused. A further advantage is that of being able to move down hill independently of the periodicity of the generator station.

Careful attention was paid to the important question of brakes, and we find that besides a strong mechanical brake acting on the rack pinion axle, there is a band brake connected with an extension of the motor shafts and also a magnetic or electric brake.

There are two drivers to each locomotive. As will be seen from the motor cuts, the handles in front work the main mechanical brake.

The two rack pinions are 28 ins. at the pitch diameter, the number of teeth being twenty-two and the pitch 4 ins. At either side of the rack pinions are grooved wheels 4 ins. broad, each with four V-shaped grooves into which fit iron clamps at both sides of the horizontal diameter. Thus by turning either of the handles the brake acts at eight points simultaneously.

At both ends of these axles are the spur-wheels of the second gear; the reduction is 2 to 1, the pitch being 1 in.

One view of the locomotive shows the mitered wheels of the first gear, where the reduction is 5.6 to 1 and the pitch slightly less than 1 in. The magnetic brake has now been discarded in favor of the direct-current dynamo when going down hill. In the lettered view *BB* represents the band brake operating on the motor axles *D*, the two wheels constructed especially for strength and friction. *V M* is a small motor connected to a fan and employed to cool the resistance on coming down hill. The resistance consists of a ribbon stretched over porcelain insulators. The size of the resistance boxes has been greatly decreased since the direct-current dynamos have been used. The switch handle cuts in and out the resistances of both motors at the same moment, one of the switches only being visible in the cut. The cylindrical tank at the back of the resistance box holds water for drenching the brake if overheating takes place. The speed counter standing at the back is belt-driven from the motor shaft, and is easily seen from where the drivers stand. Mounted on the inside of the locomotive car are switches for reversing and breaking circuit, as well as fuses and instruments for measuring the current and voltage.

Those locomotives now building at the Maschinenfabrik Oerlikon are being provided with apparatus and machines connected according to the diagram, Fig. 10. The electromagnetic brake is of the pattern commonly used for lifts where a strong spring draws two friction clamps onto a wheel, and only releases them when the current passes through the electromagnet. This brake is not in use when the direct-current dynamo is working, but is always in circuit when the locomotives are going up hill.

The railway was commenced in 1897, and at the time of writing a point two miles beyond Little Scheidegg station has been reached. The approximate position can be traced from the map, Fig. 2, which shows the relative distances between stations as well as the gradient at every part of the track. It will be noted that there is always a continuous grade in the same direction, so that whatever happens to the electrical plant, the locomotive can always be brought safely back to the Little Scheidegg. The first 6500 ft. were open country and presented comparatively few difficulties, but the boring of the tunnel was by no means light work.

The first half of the tunnel passes through hard chalk, the second through schist and gneiss, this being a form of hard slate. Fortunately both these minerals are very hard and no masonry is required except, of course, where iron hooks, angle-irons, etc., are let in the side of the wall. It is astonishing how evenly and accurately the surface of the tunnel has been kept by blasting. For boring, percussion drills have been found the most successful; the distance bored is usually one meter, and for blasting the most effective and at the same time safe explosive has proved to be gelatine dynamite.

FIG. 13.—A GROUP OF TRANSFORMERS.

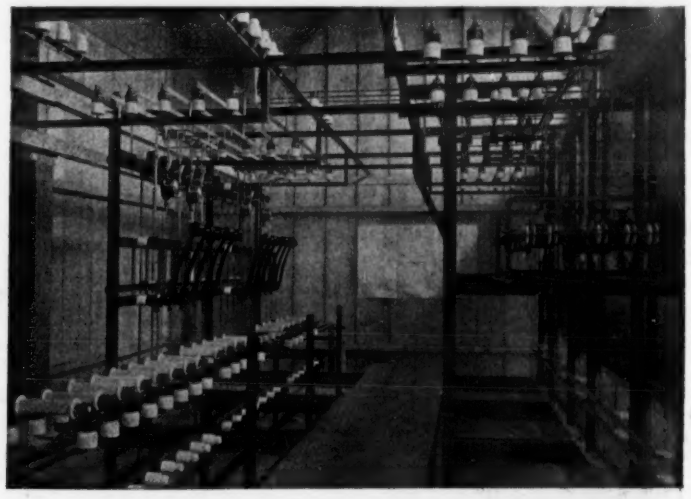


FIG. 14.—ONE OF THE SUB-STATIONS.

Outside the tunnel it was necessary to build a house, repair shop, food and medicine stores for the workmen and engineers, food having to be stored, since it is often impossible to send up provisions regularly, owing to snow. A common temperature is —13 degs. F., and contrary to what one would expect, the workmen are nearly always Italians. When work is in full swing 200 men are occupied during three shifts of eight hours, sixty being engaged on the tunnel work at each shift. The average day's work represents an advance of only 3½ to 4 meters.

In the open, the ties are of wood, but those in the tunnel are of cast iron; the distance between ties is 40 ins., but where the ends of the rack are jointed this distance is reduced to 20 ins. The length of the ties is 5 ft. and the breadth 10 ins.

The rack was designed and patented by Engineer Strub, of Interlaken. As already mentioned, the number of teeth on the rack pinion is twenty-two and the pitch 4 ins. The rack is laid in lengths of 10 ft.; the height above ties is 7 ins., the pitch 4 ins., the breadth of tooth 2½ ins., and depth of tooth 2½ ins. Throughout the whole distance the rails are of steel and rolled in lengths of 33 ft.; their height above ties is 4 ins., and weight 42 lbs. per yard. The gauge is 3.28 ft.

Traffic is now open between Scheidegg and Rothstock. Eismeer will be reached and opened in 1903, and if progress continues at the

rate hitherto maintained, we may expect to see the whole railway finished between the years 1908 and 1910.

The Jungfrau Railway Company has recently issued the following list of fares, etc., between the Little Scheidegg and Rothstock:

Stations	Height		Distance			Time		Price	
	Between stations	Above sea level	Between stations	From Start	Max. rise	Station to station	From start	Single	Return
	Meters	Meters	Meters	Meters	in %	Minutes	Minutes	Francs	
Little Scheidegg	—	2064	—	—	—	—	—	—	—
Eigergletscher	258	2322	2015	2015	24.1	16	16	2	3
Rothstock	210	2532	865	2880	25.	8	24	3	5

When the railway is finished a return ticket from the Little Scheidegg to the summit of the Jungfrau will be 35 francs.

It is estimated that every meter of tunnel with full electrical equipment complete costs 350 francs, and the cost of the entire railway when finished, including generating stations, rolling stock and everything, will be $2,000,000.

The line at the present stage is exceedingly interesting, and so far as engineering is concerned, offers as much instruction as it will when finished. The view from Rothstock is beautiful, but those who journey to the summit when the railway is finished will be rewarded by a panorama equal to the most magnificent the world can show.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—VI.

By J. E. Woodbridge.

THE HIGH-TENSION FEEDERS.

THE feeders from the generating station to the substations are triple-conductor cables, each conductor having a cross-section equivalent to a 0000 rod. These cables are of course underground in all cases, an interesting feature of the entire circuits of this railway system being the fact that there is not a foot of overhead wire, either high-tension or low-tension feeders or trolley conductors. Therefore no lightning arresters are necessary, either in the main station or the substations. The high-tension cables, however, must be protected against static troubles, this protection being obtained by means of static dischargers, which are exactly the same as lightning arresters. A set of these dischargers is connected at each end of each feeder. Each cable end is flared out in the usual bell-mouth form to prevent static discharges from piercing the insulation at this point, which they usually prefer.

As noted above, the bus-bars are connected to the feeders through what are termed group circuit breakers, each of these 20 circuit breakers supplying four of the 80 feeders, an oil circuit breaker also being placed in the outgoing end of each individual feeder. This arrangement gives virtually two circuit breakers in series with each other between the bus-bars and each feeder so that if one fails to respond to its controlling switch or holds an arc the other can be opened. By putting four feeders on each group circuit breaker the number of circuit breakers necessary for the 80 feeders is reduced to 100 instead of 160, which would be necessary were there two circuit breakers in the outgoing end of each individual feeder.

Referring to the diagram of connections of the generating station, it will be seen that the controlling switch of the feeder circuit breaker

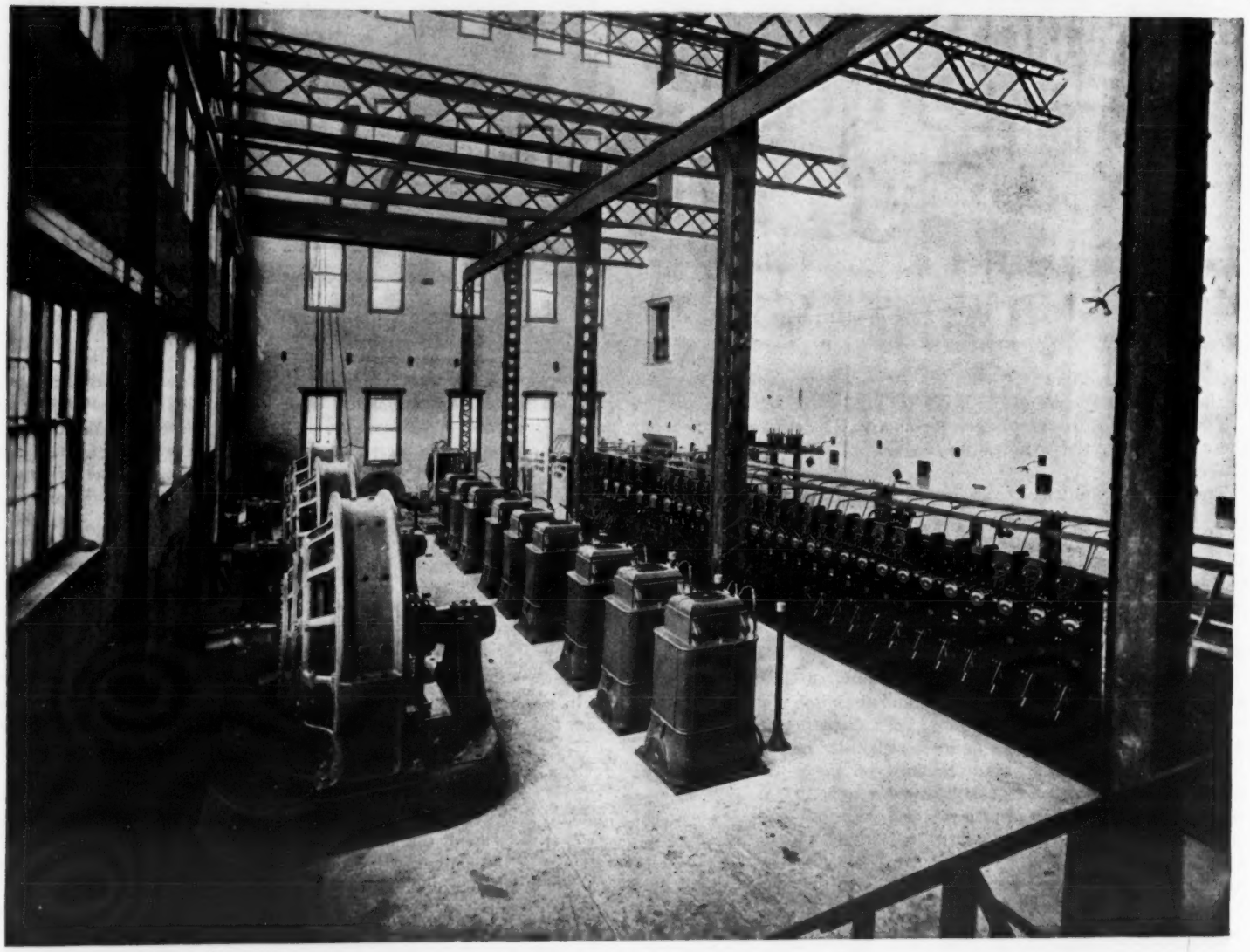


Fig. 23.—General View of the 146th Street Sub-station.

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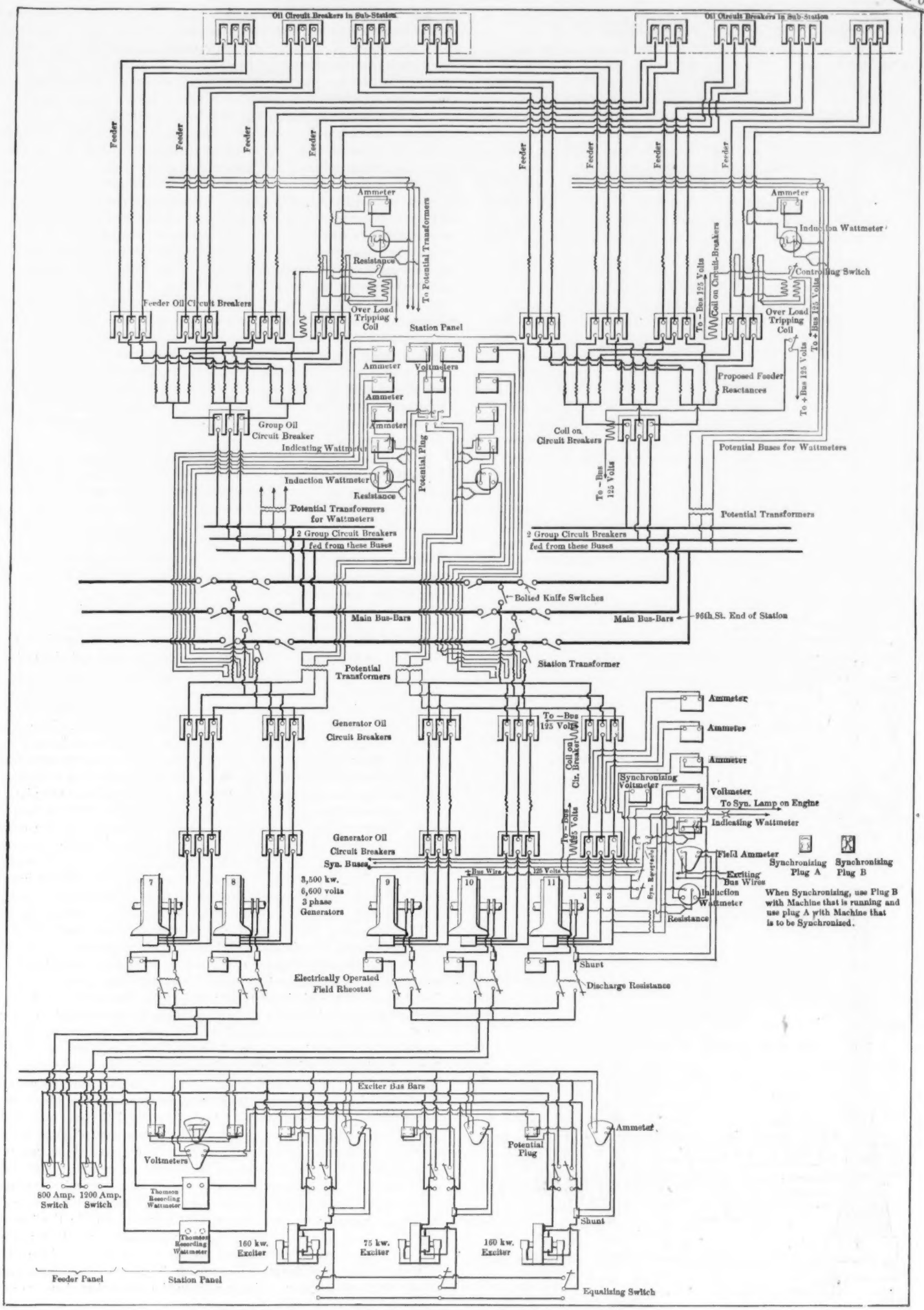


FIG. 24.—GENERAL DIAGRAM OF CIRCUITS OF GENERATING STATION.

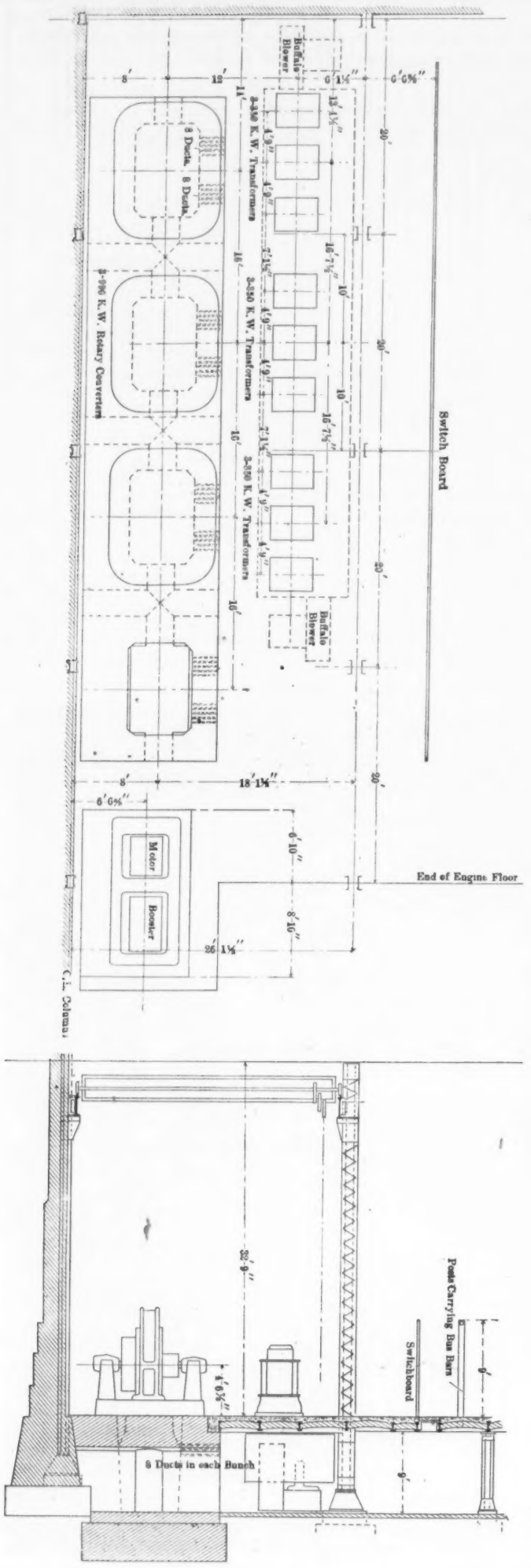


FIG. 25.—FLOOR PLAN AND ELEVATION OF 146TH STREET SUB-STATION.

is fitted with the first form of automatic overload relay described above in the section of this article devoted to the oil circuit breakers. This makes the feeder circuit breaker open automatically in case of overload. Each feeder also has an oil circuit breaker at its incoming end in the sub-station, this circuit breaker being fitted with an automatic releasing device actuated by reverse-current relays. All the feeders entering each sub-station are connected together in high-tension sub-station bus-bars after passing through their automatic reverse-current oil circuit breakers. The purpose of the overload relay at the power station end, and the reverse-current relay at the sub-station end is to automatically cut off at both ends any individual feeder on which a short circuit may occur, leaving the other feeders in service between power station and substation. For instance, if a short circuit occurs upon any feeder between the power station and a sub-station, and in parallel with several other feeders connecting the same points, there will be a rush of current into it from the power station bus-bars which will operate the automatic overload relay and open the oil circuit breaker at the outgoing end. There will also be a rush of power back into the other end of the same feeder from the sub-station bus-bars, this power coming in part from the rotary converters and storage battery and in part from the power station via the other feeders. This rush of power from the sub-station bus-bars into a short-circuited feeder will operate the reverse-current relay at the substation end, opening the oil circuit breaker. Thus the short-circuited feeder will be automatically cut off at both ends.

If both ends of each feeder were fitted with automatic overload release and all feeders were working under full load, it is obvious that a short circuit in one might pull back enough current from the sub-station bus-bars—before operating the overload circuit breaker at this point—to open the overload circuit breakers in the other feeders at either their outgoing or incoming ends or both, thus cutting the sub-station entirely off from the power station. This is the reason for using reverse-current relays instead of overload relays at the sub-station ends of the feeders.

THE SUB-STATIONS.

As indicated in the map of the Metropolitan Railway lines published in an early part of this article, there are planned six railway sub-stations, one of which is to be included within the generator station itself, the transformer and rotaries of this sub-station being located below the exciter room, which in turn is below the switchboard galleries described in a previous section of this article. The other five sub-stations are located in the company's cable and temporary electric power stations or car barns, the apparatus in some cases taking the place of cable or temporary electrical generating equipments displaced by the new power system. These sub-stations are planned for the present to contain from three to six 1000-kw rotary converters each. Four of them are already in operation, the installation of apparatus in the other two waiting until the engines of the Broadway cable system can be removed, when the tracks are changed—as they will be during the coming summer—to accommodate electric instead of cable cars. A brief summary of the layout of the sub-stations may be of interest before the details of the equipment are taken up.

The incoming high-tension cables are brought together—after passing through their oil circuit breakers—in high-tension bus-bars, the step-down transformers obtaining their power through oil circuit breakers from these bus-bars. The step-down transformers are in all cases of the air-blast type, rated at 350-kw each with a transformation ratio of 6000 to 350 volts. They are connected in groups of three with no cross connections between the groups on the secondary side; i. e., there are no low-tension alternating-current bus-bars. Each group of three transformers feeds one rotary converter, to which the secondaries of the group are directly wired, there being no means of switching any rotary from one to another group of transformers. This arrangement is adopted to avoid the use of switches in the low-tension heavy-current alternating-current circuits as well as to avoid the transference of stray direct currents from rotary to rotary through the alternating-current connections, which transference takes place when two or more rotaries are electrically connected to the same low-tension alternating-current bus-bars. There are no switches, fuses, instruments or current transformers in the low-tension leads from the transformers to the rotaries, hence all alternating-current switching, measuring and synchronizing must be done on the high-tension side of the transformers, each group of transformers and its accompanying rotary being a unit in the sense that they are never switched apart, are never run separately, and are always thrown in and out of service together. Each sub-station contains a powerful

storage battery with differential booster to relieve the alternating-current system of load fluctuations as well as to provide a means of starting the rotaries from the direct-current end and an unfailing source of current for sub-station auxiliaries, such as air compressors, magnets of oil circuit breakers, station lighting, etc.

Fig. 25 shows a floor plan of the apparatus in the 146th Street sub-station, a general view of which is given in Fig. 23. The oil circuit breakers and high-tension bus-bars are not shown in this plan, but are located behind the switchboard. Local conditions of the structure necessitated the general arrangement of the apparatus as shown, this not being considered an ideal arrangement. What is termed an ideal arrangement, and one that will probably be adopted in the sub-stations built in the future, places the apparatus consecutively in the order in which the power passes through it. For instance, at the side of the station on which the high-tension feeder pit comes in the oil circuit breakers of the feeders would be located. Beyond them would come the high-tension bus-bars, beyond them the oil circuit breakers feeding the transformers, beyond them the step-down transformers themselves, then the rotaries, then the switchboard, and finally the direct-current feeder pit. This would prevent any high-tension cables running past any low-tension, any low-tension alternating-current cables running past the direct-current, etc., isolating the different classes of wiring and avoiding crowding, which with such powers and voltages gives some risk of spread of faults.

Special Apparatus for Testing Cables Rapidly and Accurately.

By Henry W. Fisher, M.E.

The theory and practice of general cable testing is perhaps the simplest of engineering problems, and yet one is frequently confronted with phenomena apparently at variance with theory, and with problems difficult to solve. In the beginning of the last decade the author, in his capacity as electrical engineer for the Standard Underground Cable Company, began to realize the great need of modifying the prevalent arrangement of cable-testing apparatus so that the various tests could be made with rapidity and at the same time without the possibility of mistakes. Acting upon this conviction, additions or changes were made from time to time, until an arrangement was worked out that gave great satisfaction.

The first problem was to devise some plan for reducing the vibration of the galvanometer needle, due to the heavy factory machinery. The utilization of all available space precluded the erection of a special laboratory building. After numerous attempts with different devices, the following plan which has always given unqualified satisfaction was adopted:

The galvanometer, lamp and scale were placed on a platform suspended from 40 springs. Underneath and attached to the platform was a lead casting weighing about 500 lbs. and having a base in the shape of an elliptical spheroid which rested lightly on a soft rubber diaphragm. The latter covered an air-tight chamber, which could be inflated with air to any desired degree so as to vary the pressure between the diaphragm and lead weight. The last-mentioned device serves to counteract the vibration due to the springs, and also to prevent the platform from swinging as a pendulum. The scale was mounted on ball-bearings and by means of a suitable device could readily be moved back and forth horizontally so as to place the spot of light at zero without shaking the galvanometer. This plan still gives the best of satisfaction and is proof against the very perceptible sudden jars of a 40-ton steam hammer in a mill close by.

At the same time the above improvements were being made it was deemed advisable to design a special switch which would make all the connections for any one test. This switch had five separate positions, and was provided with a pointer indicating each. The connections made in the different positions were as follows:

First position for constant of condenser; second position for electrostatic capacity of cable; third position for insulation resistance of cable; fourth position for constant (insulation resistance) of galvanometer; fifth position for Wheatstone bridge. This switch was so designed that most of the metallic contact points were used at least twice, thus minimizing the actual number of parts.

Experience showed that when many tests of insulation resistance and electrostatic capacity have to be made it is advisable to have a resistance in circuit when the battery is applied. The reason for this is that, in spite of a due amount of care, the conductor under test will occasionally get in contact with the lead sheath or with some of the other conductors in the cable. The effect of this would naturally be to reduce the e. m. f. of the battery when the test is applied, thus not only necessitating the redetermination of the constant, but also the use of a different battery, owing to the fact that the e. m. f. of the first battery would gradually increase, for which reason it could not be used until its e. m. f. had become constant.

A few experiences of this kind showed how advisable it was to have a resistance in circuit with the battery, and hence the special switch was so designed that the standard one megohm was always in circuit when the insulation resistance of the cable was being determined; also that a resistance of about 40,000 ohms was in circuit when the cable was charged to measure its electrostatic capacity.

In the former case when great accuracy is desired it is necessary to subtract one megohm from the calculated absolute resistance to get the true insulation resistance of the cable. In the latter case, when cables of low insulation resistance are being measured, the resistance in circuit must be cut out. As the cables seldom test less than several hundred megohms, no corrections are in general necessary.

The difficulty of reading the insulation resistance deflection of galvanometer accurately at the end of one minute, when electric-light cables with much evidence of electrification are being tested, suggested the design of a double-pole, double-end reversing keys, fastened on two pillars in the middle, and provided with a button operating both keys at each end. Wires leading from the galvanometer were connected to the spring brasses on top of the middle posts.

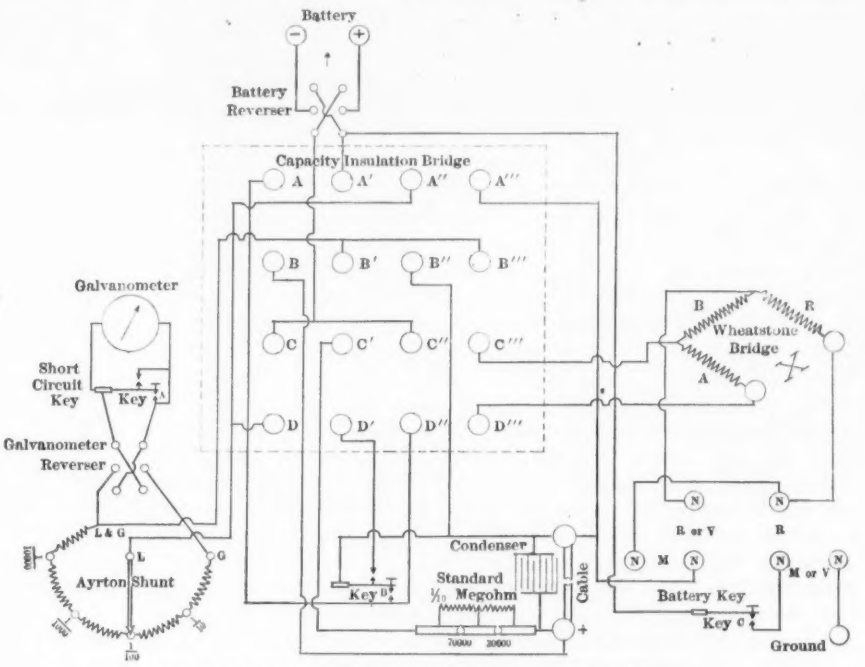


FIG. I.—PLAN OF CONNECTIONS OF CABLE-TESTING SET.

The end posts were provided with contact points directly underneath those of the two spring brass keys. An e. m. f. was connected in reverse direction to the end post contact points. Hence, when one button was pressed the galvanometer needle would be deflected in the opposite direction from what it would be when the other button was pressed. The e. m. f. was obtained from a thermal couple, consisting of a copper and iron wire soldered together, and placed near the lamp used in getting the spot of light for testing purposes.

This apparatus gave excellent satisfaction. For, supposing that the galvanometer deflection had been checked as well as possible by the galvanometer short-circuit key, and a few seconds before the end of one minute it was noticed that the deflection began to become rapidly less; then the above-mentioned key could be used to materially reduce the deflection by pressing the right end button, and then bringing the deflection to a stationary point by pressing the other button, when the correct deflection at the end of one minute

could be read or approximated to by observing which way and how much the spot of light moved.

With these various improvements it was found that the work of testing could be done with great rapidity and accuracy. Inspectors of telephone companies who were testing cables for their respective companies were so well pleased with the outfit that by special request they were furnished with designs of it. When my company decided to build two new factories it became necessary to provide excellent facilities for testing, and having in mind several improvements over the above-described testing arrangements the author immediately started the design of a self-contained testing set which could be used to great advantage for portable purposes.

The primary object was to have as few connections as possible and to carefully consider the design of every part so as to insure simplicity of operation and a long life. The work of adjusting the standards, shunts, etc., to their rated values was carried out to a high degree of accuracy. It is a comparatively easy matter to adjust resistances to their rated values, but it is much harder to do so with condensers. The author found that the condensers of both testing-sets were adjusted to less than .3 per cent of the rated values, and that they were really more accurate than a standard Elliott condenser which was imported for calibration purposes.

Evidently the simplest plan would be to arrange the switch with three positions—one for "capacity," one for "insulation" and one for "Wheatstone bridge." By arranging the condenser so that it could be connected in multiple with the cable posts, both the constant of condenser and electrostatic capacity of the cable could be obtained with the special switch in the first position. This was done, and in addition a .1 megohm resistance was so connected through the special switch that it could be in circuit or not by the removal or insertion of its plugs, when the cable or condenser was being charged and would be out of circuit when they were discharged through the galvanometer.

This, as has previously been shown, is the condition for efficient and rapid testing. The .1 megohm was made up of two resistances of 30,000 and 70,000 ohms; the former is sufficient to prevent the battery e. m. f. from decreasing in case of a short-circuit during the interval of charging.

In like manner, the special switch makes the necessary connections, so that the .1 megohm can be placed in circuit or not by the removal or insertion of its plugs when the switch is placed at "insulation." Hence to obtain the constant of the galvanometer it is only necessary to short-circuit the cable posts by inserting a plug at *G*, Fig. 4, and then take the deflection in the ordinary manner, the plugs of the .1 megohm being first removed.

When the special switch pointer is placed at "Bridge," resistances can be measured and faults located by the Murray and Varley loop methods, it being necessary first to connect the battery and galvanometer to their respective posts, and to place the bars *C* and *D* over the letters *R*, *M* or *V*, respectively, for resistance. Murray or Varley loop. To insure perfect contact, knife and jaw switches were used as much as possible.

Figs. 2 and 3 show the construction of the special switch. It will be noticed that the hard-rubber insulators have grooves turned into their ends to reduce the possibilities of surface leakage and thus insure more perfect insulation. The hard-rubber insulators holding the metallic parts shown in Fig. 4 screw into the base and are of the petticoat type, insuring excellent insulation, even in the dampest weather. Two-pole, double-throw switches are used to reverse or break the battery or galvanometer circuits. These are mounted on the special hard-rubber insulators.

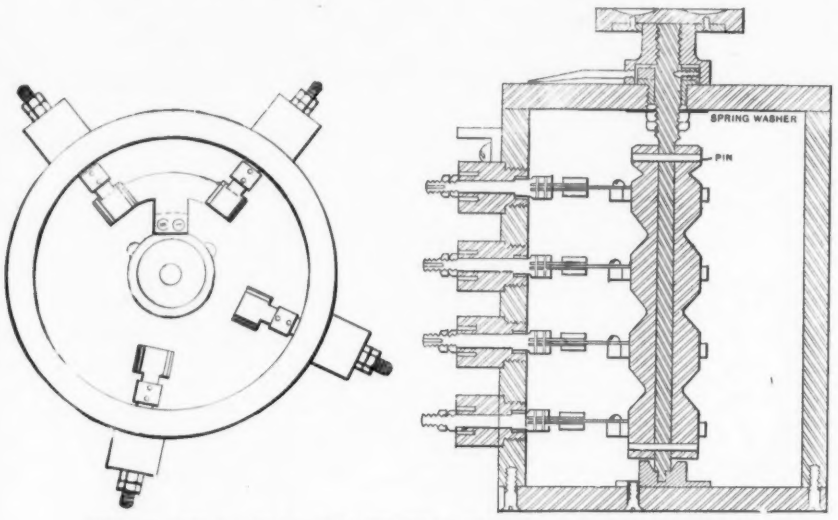
The galvanometer short-circuit key is of a special type which the author has used for a number of years. It has two buttons, and when one of these is pressed down a permanent reliable short-circuit is made through a knife and jaw switch. When the other is pressed down and released the short-circuit is removed, and upon repeatedly pressing it down and releasing it the galvanometer can be intermittently short-circuited to prevent the needle from moving too far, as is necessary when making tests of insulation resistance. The hard-rubber buttons of all the keys are also of the petticoat type, so as not to introduce leaks due to moisture on the fingers.

The shunt is of the Ayrton universal type, and hence can be used with galvanometers of any resistance. The horizontal galvanometer is remarkably sensitive, giving a constant of over one megohm per volt. With an auxiliary battery of 100 volts, therefore, one division would mean 100 megohms, and the instrument would indicate between 500 and 1000 megohms.

The battery has an e. m. f. of 1.5 volts per cell, and appears to stand rough usage much better than the silver chloride cells. It can be connected to the battery posts by flexible ends. The galvanometer posts can be connected to the horizontal galvanometer through *E* and *F*, or to any other galvanometer by leading wires. The condenser is of the multiple-series type, and has 16 different combinations, ranging from .02 to .5 microfarad.

The arrowhead indicates the direction the galvanometer needle will move when the handles of the reversing switches are placed as indicated by arrowheads and the battery polarities are connected as marked. This affords a means of determining polarities. Under like conditions when making bridge tests, if the needle moves toward the plus mark, then the resistance in the rheostat must be increased to give a balance. This materially aids the operator in working rapidly.

Fig. 1 shows a plan of the connections of the cable-testing set. In the first position, for capacity, the special switch makes the connec-



FIGS. 2 AND 3.—PLAN AND VERTICAL SECTION OF SPECIAL SWITCH.

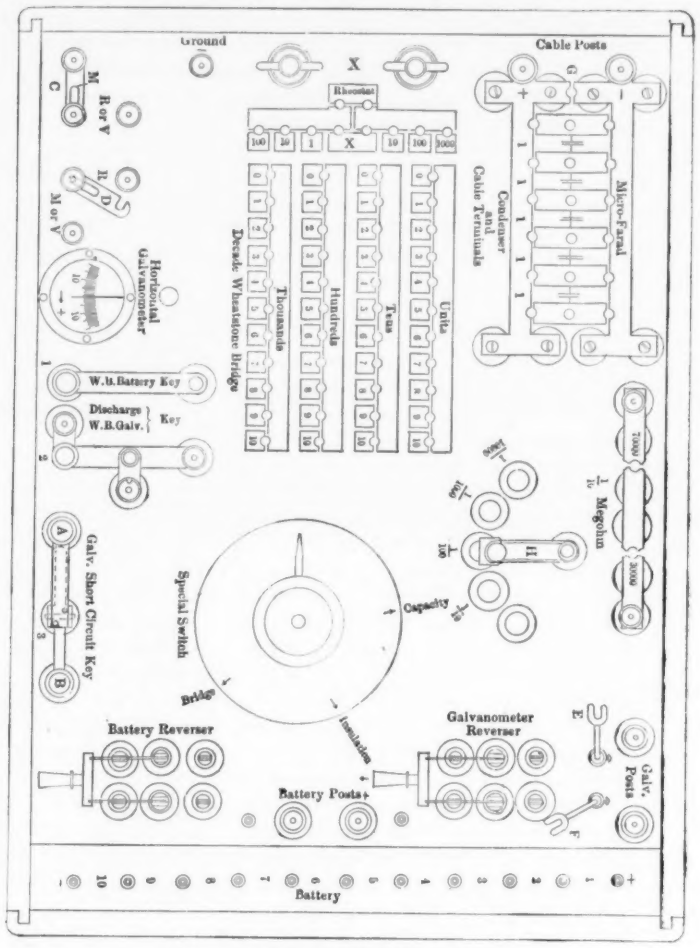


FIG. 4.—PLAN OF CABLE-TESTING SET.

tions *A* to *A'*, *B* to *B'*, *C* to *C'* and *D* to *D'*; and in the same way when "insulation" and "bridge" are indicated, the points under them are connected. By carefully following out the connections for different tests it will be found that while there may be wires tapped off here and there, yet they do not interfere with the particular test under consideration.

In conclusion, when capacity tests have to be made it is only necessary to connect a battery to "battery posts," a galvanometer to "galvanometer posts," the cable and ground to "cable posts," and place the special-switch pointer at "capacity," when the discharge deflection can be read in the ordinary manner after pressing down and releasing the discharge key No. 2. In like manner, after disconnecting the cable, and connecting by plugs a capacity across the cable terminal bars, the discharge deflection of the condenser can be read.

To make insulation resistance tests, the battery, galvanometer and cable are connected as last described, and the special-switch pointer placed at "insulation," after which the short-circuit is removed from the galvanometer by Key 3, and the deflection read at the end of the required time. Then, having connected the right shunt and being sure that both plugs are removed from the .1 megohm box, a plug is inserted at *G* and the constant of the galvanometer obtained in the ordinary manner.

When making several repeated insulation resistance tests of the same conductor, it is necessary at the end of each test to discharge the cable by short-circuiting it for several minutes. This can readily be done by inserting a plug at *G*, or by placing the special switch at "capacity." When the latter is done, the discharge current can be observed from time to time by pressing down button *B* of Key 3 to remove the galvanometer short-circuit, and then reading the deflection. This affords a ready and sure means of telling when the cable is discharged.

A well-known authority on cable-testing observed to the writer on one occasion that he was afraid there would be trouble from leaks in damp weather with a combination set like the above, and this would have been the case had not the greatest care been exercised in the design and construction of the insulators. As it is now, no trouble is experienced even in the dampest weather, an extremely sensitive reflecting galvanometer, giving a constant of over 500,000 megohms, being used with the set.

A prominent electric light and power engineer said on one occasion that when he made insulation resistance and capacity tests, it took him the larger part of the time to get ready, because he did not have enough of this kind of work to do to keep thoroughly familiar with it. It, therefore, appears to the writer that the above-described set is not only of great advantage to the person who has much testing to do, but also to him who has little, and especially to persons who have to commence testing without having had much experience.

Telephone Service in Tokio, Japan.

In a recent issue of the Japan *Times* is an article showing the inadequacy of the telephone service of Tokio. At the end of February the number of subscribers was 5,645, while 5,641 applications were on file waiting for installation of service. According to schedule, 1700 of these applications were to have been supplied with instruments by March 31, but owing to delay in receiving the necessary wire it now seems as if this part of the work will not be done until June, and at rate of putting in the balance as now planned, with such additional applications as may be made, three or four years must elapse before anything like an adequate service can be given. Premiums as high as 400 yen ($200) have been paid subscribers for a transfer of instruments, by persons who want the service more than the fortunate possessor of the 'phone; and one holding the receipt of an application made before June, 1897, can get about 250 yen ($125) for the transfer of the application.

University of Minnesota.

Among the interesting problems being taken up by the senior electricals are the following: Internal Illumination as Affected by Various Arrangements of Lights and by Different Colored Walls; Train Lighting; Pumping Action of Rotary Transformers; Automobile Controllers; Accuracy of Integrating Meters as Affected by Various Conditions such as Temperature, Frequency, Pressure, Current, etc.; Comparative Study of Direct Current and Alternating Current Arc Lamps.

The Properties of Carbon in Electrical Work—I.

BY ELIHU THOMSON.

THE elementary substance carbon bears such a unique relation to the electrical development in these later years that it may possibly be interesting to make this brief statement concerning those properties, both physical and chemical, which are especially valuable in this connection.

Since the discovery by Davy, almost at the opening of the present century, that the current of a powerful voltaic battery would after contact and separation of two electrodes of hard charcoal, maintain itself in a brilliant arch or arc of flame while a most intense light was radiated from the heated ends of the carbon, the interest in the phenomenon has been unabated. Though other conductors may yield similar arcs, the carbon arc has held the field in practice, and there is to-day no effective substitute for carbon even outside of the question of expense. The purer the carbon the more satisfactory the result.

Innumerable experiments with mixtures containing more or less carbon have been made, but none are of practical value. It is proper to inquire why carbon occupies the position that it does in electric arc work. I use the word carbon in this connection as indicating the black, compact variety, capable of conducting electricity. It is usually made from some carbon powder, such as ground petroleum coke or other nearly pure carbon residue, cemented by gas-pitch or tar, moulded into the form desired and finally baked or carbonized at a high temperature. This baking is continued for many hours and results in the loss of nearly all volatile matter.

The carbon rods or pencils so made have a moderate electric conductivity, $\frac{1}{2000}$ or less as compared with copper, though this property varies widely with the density and manner of production of the particular specimen. The value of carbon for the electrodes of arc lights depends, first, upon its absolute infusibility and its high temperature of sublimation. It has never been melted and appears to be incapable, like arsenic, of existing in the liquid state at normal pressures. It could probably be melted if heated electrically under enormous pressures in an inert gas. Estimations of what pressure would be needed are of the order of 15 to 20 tons per square inch. It is conceivable that carbon may exist in great quantities in the liquid state within the bodies of some of the stars. In the electric arc the carbon at the positive pole or crater reaches its sublimation temperature, according to Violle, at about 3500° C. The stream of carbon vapor evolved from the positive crater surface, in a normal arc in open air, is gradually oxidized into CO_2, which constantly escapes. If, however, the arc be too short, as when the carbons are not sufficiently separated, some of the carbon vapor fails to be burned in the flame, and is deposited upon the cooler negative carbon, giving rise to what are called mushroom growths of pure plumbago or soft graphite. The products of combustion of the carbon being colorless gases, they do not interfere with the evolution of light and practically no fumes are produced. The sublimation temperature is so high that light is most efficiently generated; about 10 per cent. of the heat energy is radiation consisting of luminous rays. Before the carbon is vaporized it is first converted into plumbago for a short distance from the extremity of the carbon rod at the arc. This fact led me, about twenty years ago, to propose the manufacture of artificial plumbago by passing heavy currents through slabs of agglomerated coke dust, shut in by a loose granular mass of coke for preventing radiation and loss of heat. In this way the temperature may be carried, even by a moderate rate of expenditure of energy, up to incipient sublimation of the slabs. This was, so far as I am aware, the first suggestion of electric furnace work in which no electric arc is formed. The carbon becomes plastic, as I found in some experiments made in 1882, and could, at the high temperature, be bent or shaped like fairly stiff clay. Recently the artificial production of graphite or plumbago from anthracite coal or coke has been undertaken at Niagara, using processes worked out by Mr. Acheson, who discovered carborundum, and established the works for its production. Another valuable property of carbon which enhances its utility in electric arc work and also for electrodes of electric furnaces, is its low heat conduction. The efficiency of light production in the arc depends on keeping the heat produced by the current strictly local to the arc and ends of the carbons, or to those surfaces immediately concerned in light radiation.

If, as with metal electrodes, the heat were rapidly transferred along the length of the carbon pencil, much more energy would be

required to keep the carbon up to sublimation temperature. In fact, I have known carbons to have been made, mistakenly, so hard and dense as to become relatively very inefficient for use in arc lighting. The only compensation was that they did not burn away so rapidly as those of more open texture.

And here we can recognize another valuable characteristic of carbon. Its state of agglomeration or its density may be widely varied and the electric conductivity remain sufficiently good in all cases. This property may be called its adjustability of resistance in relation to work for which it is needed.

The use of too large a diameter of carbon rod for the current in the arc has the same effect of conducting off the heat and lowering the efficiency, at the same time that there is the added detriment of hindering the radiation of light from the ends at the arc which are then more blunt and closer together.

Naturally, it was early recognized that the objection to carbon was its free combustion in air, and attempts were made, even as far back as the forties, to prevent this by exclusion of air. As often happens, however, the art was too young. The attempts generally failed from the presence of impurities, as iron and clay, in the carbon, giving rise to fumes which in escaping from the arc would soon obscure the surrounding enclosing globe and make it relatively opaque.

Within a few years past it has been possible to obtain carbons so pure and uniform that they could be used in a small glass enclosing vessel preventing free access of air to the hot carbon. A very great extension of arc lighting has followed in the use of what is known as the enclosed arc lamp. The chief objection to carbon was thus overcome. Carbons which before would only last in open air about eight hours may last 100 to 150 hours when enclosed. Enough oxygen must, however, even in this case be allowed to leak in to consume the sublimed carbon at the arc. Otherwise it may escape and go down upon the glass in a state of fine division, so obscuring the surface. The enclosed carbon arc is different in some respects from the open-air arc. The carbons burn with nearly flat ends of the full diameter of the carbon pencil. This requires a greater separation to let out the light freely, and in consequence a higher voltage to maintain a proper arc. This wider separation or longer arc is also required to prevent deposition of carbon on the negative carbon in the form of mushrooms or stalagmitic growths which would soon deform the electrode. It is easily seen that where the oxygen is deficient such a process would be much favored. The open-air arc may be termed normal at 40 to 50 volts, while the enclosed arc demands 70 to 80 —to sustain its longer flame. The combustion in the enclosed arc results in the production of carbon monoxide owing to deficiency of oxygen, but the combustion of the carbon is so slow that it has no appreciable poisonous effect in the surrounding air.

Hertha Ayrton, the distinguished wife of Professor Wm. E. Ayrton, of London, has given much time to the study and experimental investigation of the electric arc, and has found that the presence of oxidized products such as CO_2 between the carbons where opposed, is the cause of the phenomenon of hissing and instability noted when arcs in open air are run too short. The hissing is accompanied by sudden fall of potential across the arc, indicating less energy required to be expended in passing the current. These effects were quite absent in arcs surrounded by dry hydrogen. The enclosed arc, owing to oxygen exclusion, is much less liable to these irregularities than the open-air arc. Leaving, for the moment, the question of cost, there appears at present to be no possible substitute for carbon in lighting by the electric arc, and certainly the cheapness, workability and adjustability are factors which, added to its other qualities, make it specially adapted for that use as well as for electric furnace electrodes. Such furnaces as those in which the electric arc is the heating agent, as in the manufacture of carbide of calcium, depend upon the carbon arc alone.

The position which carbon occupies in incandescent electric lighting is no less unique. The filament or "burner," which *doesn't* burn, is invariably composed of carbon, and there is no present prospect of its displacement in favor of any other substance. It will be remembered that Edison worked for two years without success upon a lamp having as its incandescing conductor a wire of iridio-platinum heated in the open air. Experiments had been made by others using thin carbon rods in open air, fed forward as fast as they were consumed. When Edison here and Swan in England made use of thin strips of carbonized material with the complete exclusion of oxygen obtained by the use of a vacuous enclosing bulb, success was immediate. Even this work had been foreshadowed by Starr away back in the forties. The vacuum bulb, far from being a disadvantage, not only afforded physical as well as chemical protection, but in addition greatly increased the economy of light production by abolishing loss of heat by gas convection. As with the arc the property of infusibility and high sublimation temperature, or low vapor tension even at high temperatures, make carbon practically the only available material for incandescent lamps.

The life of such lamps would be very short if at the temperature of working or incandescence there was any sensible evaporation of the carbon. But after all the working temperature has been selected low enough to avoid rapid deterioration, it being well understood that the efficiency of the lamp would rise very rapidly with moderate increase of temperature. If forced too far the carbon does apparently gradually evaporate. It also softens and bends by its own weight. But it nevertheless retains considerable rigidity even up to the point of rapid sublimation by excessively high temperature. In one instance an assistant accidentally connected a 25-volt lamp across mains at 1000 volts, but only for a fraction of a second. The lamp actually remained intact except that surrounding the filament, as an exquisitely delicate black mantle about 3/8 of an inch or more in diameter, was a deposit of carbon. It had been suddenly evaporated from the carbon into the vacuum and condensed at a short distance away from the filament. The walls of the glass bulb were left perfectly clear and the filament was apparently uninjured. The darkening of the glass bulb of an incandescent lamp after prolonged use indicates the slow deterioration of the carbon filament by loss of its substance. Whether this loss is due to a true evaporation or to gas attrition, or whether the carbon is carried by electric discharges traversing the vacuous space around the filament is not definitely determined. The deposit may be due to a combination of all these causes. The formation of an incipient deposit of fine carbon is indeed helpful in the sense that it improves the vacuum by taking up the residual gas. During use the vacuum of a good incandescent lamp gradually perfects itself.

On letting in the air to a lamp bulb blackened by long use and heating the bulb the sotty coating readily burns off, and this at a temperature so low that there is no risk of softening the glass and deforming the thin bulb. The powder deposited in the glass seems to be oxidized with great facility.

Turning now to the manufacture of the lamp, it will be noticed that the properties of carbon and some of its compounds greatly favor the manipulation. Formerly filaments cut from paper or bamboo were used. After these came parchmentized thread bent over a carbon form and carbonized at high temperatures with exclusion of air. At present the practice of squirting a viscous cellulose solution through a small hole into a coagulating liquid is almost universal.

The gelatinous thread so formed is wound upon a drum and dried, thus becoming very considerably smaller and quite tough and horny. These cellulose threads are wound upon carbon forms in the shape desired and carbonized at a high temperature. This gives a structureless carbon thread or wire of uniform texture and size. Subsequent operations are directed to standardizing the resistance at the working temperature. The adjusting operation utilizes another property of carbon compounds. The process is called "flashing" and consists in highly heating the filament in a chamber filled with hydro-carbon vapor at such low pressures as a few centimetres of mercury, thus depositing a skin of hard dense carbon of good conductivity upon the *base*, as it is called. This "treating" or "flashing" process is conducted while measurements are made, and is stopped when the filament has reached the standard resistance. It is fortunate that such a simple method of adjustment existed. It has, however, the additional merit of tending to cause the current to flow mainly upon the outside skin of the filament where the energy should be delivered for the best results.

In a coarse filament, an equal rate of energy delivery throughout the section would be liable to overheat the interior and produce cracks and fissures, if not vapor pressure. The effect may be illustrated by the following experiment. Let a thin strip of carbon such as a lamp filament be immersed in liquid gasoline and an electric current be passed through it so as to bring it to a high temperature under the liquid, which goes into the spheroidal state and virtually surrounds the hot carbon with a layer of vapor. In this case the filament gradually thickens by carbon deposition. As its diameter increases, more and more current will be required to keep up the temperature. In this way the filament may receive such a thick deposit that it may reach say 1 cm in diameter. It might be supposed that a dense hard rod of good conducting carbon

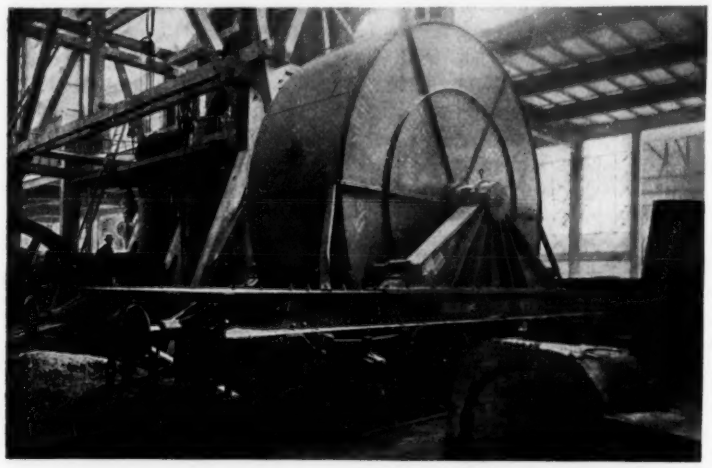
had thus been obtained. Upon examination, however, it will be found that the interior of the thick rod is quite spongy and soft. The carbon of the interior, originally dense and hard, had later become overheated owing to the outer deposits preventing cooling. The result of the overheating is to reduce automatically the conductivity of the interior carbon by vaporizing it in part and rendering what remains soft and spongy, like soft porous graphite. The various parts of the section thus adjust the rate of energy delivery to them in accordance with their ability to dissipate heat.

It may here be noted that in the same way the inner core or hottest part of the charge in a corborundum furnace, as at Niagara, becomes converted into a pure graphite, loose and spongy in texture, all other substances and even part of the carbon having been driven out in vapor. Hence carbon may be purified by bringing it up to the temperature of sublimation.

The Paris Exposition.

SHIPPING A PARIS EXPOSITION ARMATURE.

The preparations for such an affair as the Paris Exposition offer as many points of study and interest as the great show itself, and one of the things that invite attention are the methods of packing and shipment, by sea or land. It would seem that in general greater care is taken in Europe than in America, although this is true rather of special instances. While some of the European goods traveling a few hundred miles are done up as though going around the world, others arrive at the Exposition utterly unprotected, or with insufficient wrapping. Most of the American machinery has reached the



TRANSPORTING A LARGE ARMATURE—FRENCH SECTION.

show in good shape, but there are pieces of which better care should have been taken, as appliances for cleaning, repairing and handling are by no means so available as in the United States. It is a curious fact that the opening of the fine Tiffany exhibit in the section of Diversified Industries was delayed by the smashing en route of a large part of its show-case glass shipped direct from Pittsburg, yet the amount of such glass handled around the buildings without the slightest damage is almost inconceivably large.

A striking method of care in shipment is presented by the picture here shown of a large armature sent from the shops of the Société Alsacienne de Constructions Mecaniques of Belfort, France. The armature had to wait a long time for its field parts and was shunted around the machinery hall at the Champ de Mars and jarred and jolted all over the place, turning up in various sections with bewildering obliquity. But it sustained no injury, and it would indeed be difficult to inflict any serious wound on it. The whole body of the armature is encased for shipment in stout sheet metal screwed up rigidly so as to be air and water-tight; and it is then mounted on special uprights for the shaft and bearings, these being braced in all directions by heavy straps or bars from the floor up to the sides of the big drum. The armature is carried on a platform car which has a pit through which the body drops a considerable distance, but not enough to bring it in contact with anything along a track. The space thus gained, however, enables it to clear tunnels where passage would otherwise be impossible. Hitherto the pieces of electrical machinery handled on the European railroads have been comparatively small alongside those transported in America, but the same difficulties as are encountered in the United States may soon arise elsewhere unless met by ingenious methods such as that here cited. It is said that the parts of some of the latest dynamos built in America have caused great trouble as to their shipment, on account of size and bulk, and that railroad conditions are likely to impose limits as to the sizes up to which any parts of field frame, armature, etc., can be carried in the future.

NOTES.

MR. PETER COOPER HEWITT, who has for some time past been engaged in experimental work connected with newer forms of electric light, etc., has visited Paris during the month en route from Italy to London. His health is much improved, and he will spend some time in Paris with the object of noting any improvements or innovations that may be signalized by the Exposition.

ILLUMINATIONS are promised for April 29, and will probably be very fine, as all the buildings whose façades are finished will be lit up, and those that are still unkempt will not be in glaring evidence. In every direction steps are being taken to prepare a scene which will far surpass that of the opening night, and will justify the expectations that have been naturally formed where so much electricity is used.

MR. W. J. CLARKE, head of the export department of the General Electric Company, has been in Paris during the last week of April studying up the Exposition and such conditions as bear upon his own branch of work, of which he speaks most hopefully. Mr. J. J. Oolqaardt, of the company, is on the ground busily preparing the exhibit in Electricity Building. It will consist of a fine model several feet in extent, showing all the shops and factories of the company and giving a most impressive idea of the extent and nature of their work. Around the canopied model will be huge photographs and swinging easels to illustrate apparatus and plants of a typical character, in all classes of heavy electrical application.

MESSRS. S. D. FIELD, R. McCulloch, Jr., and L. W. Schell arrived in Paris a few days ago from Geneva on a visit to the Exposition and to secure some material for the extensive street railway work they are carrying out around Lake Leman with American capital. While in Paris they made quite a little investigation of the electric cab system of the Compagnie Generale des Voitures, and found it very interesting and satisfactory. But they make the point that the present method is by no means fair to the "lead cabs," as they are charged at a station so far out that they have to put in half an hour on dead mileage before they can expect to pick up any business. In the same way on the return, they have to reserve enough current to see them home. As the cabs are good for about 25 miles, and thus are subject to a discounting of nearly an hour, it would seem that at least 25 to 40 per cent of their time and charge is wasted. It is stated that some fifty of these cabs are now in commission, and that another service may also be started up with the electric cabs from London.

CONTINUED DELAY. The amount of work, in preparation, now going on at the Exposition is tremendous, and although a great deal has been done the last two weeks of April, "the greater lies before." Not only are thousands of artisans engaged in all parts of the buildings and grounds, but all the roads and aisles are blocked with packing cases ready to be emptied. The close of April saw two or three hundred freight cars around the grounds, while probably as many more are still pressing for entrance on the outside tracks. From time to time urgent notices are issued to the exhibitors to hurry up, but most of them would only be too glad to do so, could they but get their exhibits. Material is slowly coming into the Exposition, for example, that which was shipped months ago from New York. To give an idea of the exact state of things, it may be stated that the aisle in front of the exhibit of the ELECTRICAL WORLD AND ENGINEER is an unballasted track now occupied by cars or cases. The aisle in the rear of the exhibit is a broad open dirt space, just like a bad country road. The air everywhere is laden with dust and everywhere are piles of plaster, débris, planks and inchoate exhibits. Nothing but the finer weather could have made the conditions endurable. As it is, exhibitors in all the American sections are taking things with great equanimity and resourcefulness.

The Johnson-Lundell Electric Traction Company, Ltd.

Considerable interest attaches to the formation of a large new traction company in England, with the above name. Mr. E. H. Johnson, so well known in electrical enterprises on this side of the water, has been in England recently for the purpose of organizing this company, which is to operate under the patents of Mr. Robert Lundell, on a variety of apparatus including dynamos, motors, controllers, braking, methods of motor control and a system of surface-contact current supply for street car operation. The letters patent have been taken out not only in England, but in France, Germany, Italy, Austria, Spain, Belgium and Switzerland, and the company is therefore in a broad sense a parent rather than a simple operating company. The capital stock of the new concern is $1,500,000, and it has been very generally subscribed. The present directors are: L. W. Holmes, of J. H. Holmes & Co., electrical engineers, chairman; G. B. Hunter, Arthur Laing, E. H. Johnson and Henry Webb, the names all being those of men prominent in engineering and commercial life.

The inventions and devices secured by the company are for overcoming or counteracting armature reaction as embodied in the Lundell "polar-extension" machines now being made in large quantities by the Sprague Company in this country; a method for securing an arithmetical development of speed change in traction motors; a method of using car motors as dynamic brakes, capable of returning current to the source of supply against the e. m. f. of the line, at other than maximum speed; a method of operating electromagnetically from the moving car the switches of a sectional conductor surface-contact system without demanding of this means the operation of the switches directly. For the dynamos and motors, claims of very high economy and efficiency are made as based on the results already obtained in America. The Lundell controller is noteworthy for simplicity and strength; an absence of sparking, and non-use of resistance and of magnetic blow-out. The Johnson-Lundell contact system for street car lines, which has been the subject of so much careful study and development, is now said to have reached a high degree of completeness and efficiency and of general adaptation to the ends in view. It is expected that the company, outside of its traction work, will do a large business in supplying dynamos and motors for central light and power plants, and in furnishing motors for automobiles, launches, etc. In fact, licenses, etc., for automobile use of the motors have already been effected in England and France. Special uses of Mr. Lundell's inventions apply also to factories, shipyards, mines and lifts, etc., and a large amount of work offers in the field of marine electrical equipment.

The apparatus of the company, as set forth in the preliminary papers, is made the subject of a series of reports by leading engineers and experts. Lord Kelvin has an interesting analysis of the surface-contact system, which he speaks of highly. Messrs. Parshall and Hopkinson discuss the features of the dynamos and motors. Mr. E. Manville describes the merits of the motor and motor control. Messrs. Preece and Cardew and Dr. J. Hopkinson go into the details of the system of electric traction, and Lacey, Clirehugh and Sillar make a careful report of their investigation of the whole apparatus submitted to them for test at the Holmes factory at Newcastle. The report of Mr. J. F. Moulton on the chief fundamental patents is also cited.

The price to be paid for the sale of all the rights, patents, stocks acquired, etc., is said to be $1,000,000, of which half is in the full-paid stock of the company. Mr. Johnson is a vendor to the company, and Mr. Holmes' firm has an interest in the consideration paid, holding also a license and contract for the manufacture of the apparatus for the company, and under royalty for other parties. Messrs. Preece and Cardew express the opinion that the price paid is equitable, in view of the fact that the territory acquired includes all Europe and all the British colonies except Canada.

Mr. E. H. Johnson does not hesitate to avow his strong belief in the substitution of the surface-contact railway system for the present slot methods; and as to the dynamos and motors of the company, he calls attention to their marked success in America. The present great activity in electric traction development is instanced by the fact that in the United Kingdom since January, 1899, contracts for electric railway machinery have been entered into to the extent of $10,000,000. No fewer than 44 applications for tramways and light electric railways were dealt with in the last session of Parliament with a capital of over $35,000,000 and the applications for the session of 1900 number as high as 65. It will be a matter of great satisfaction to Mr. Johnson's host of friends, as well as to all who desire to see the further success of American ideas and apparatus abroad, to learn of the abundant prosperity of the new company bearing his name and that of Mr. Lundell.

CURRENT NEWS AND NOTES.

ELECTRICITY IN THE MIKADO'S PALACE.—Electric lights are being installed in a few rooms of the Imperial Court at Tokio, Japan, as an experiment.

ELECTRICAL APPARATUS NOT WANTED IN TURKEY.—According to a press cablegram, the Turkish Government has issued an irade prohibiting the importation of electrical apparatus.

MR. CHARLES F. SCOTT, chief electrician of the Westinghouse Electric & Manufacturing Company, lectured on "Electricity" last week at Wilmerding, Pa., before the Young Men's Christian Association at that place.

ROENTGEN APPARATUS.—In Roentgen tubes the anti-cathodic surface has usually consisted of either a plate or disk formed of or coated with platinum. In a patent dated May 1, 1899, Prof. R. A. Fessenden states he has found that a surface formed of osmium is much more efficient in the production of Roentgen rays, and the patent relates to an electrode plate, the face of which is coated with osmium.

TELEGRAPHIC TYPEWRITER.—A Baltimore despatch states that a full consignment of instruments to illustrate the operation of the Rowland "multiplex" telegraphic typewriter has been shipped to the Paris Exposition. This system is the invention of Prof. H. A. Rowland, of Johns Hopkins' University. An exhibit will be installed at two points some distance from each other in the Electrical Building, and thus the operation of the system will be publicly demonstrated.

UNDERGROUND TELEGRAPH AND TELEPHONE CABLES.—Sealed proposals will be received at the office of the Commissioners, D. C., until 12 o'clock m., Saturday, May 19, 1900, for furnishing underground telegraph and telephone cables for the fire-alarm and police telegraph and telephone service in the District of Columbia. Separate bids will be considered for the several items enumerated. Specifications and blank forms of proposals may be obtained by application at the offices of the Commissioners.

AUTOMOBILE TOURS.—The Committee on Runs and Tours of the Automobile Club of America has arranged for fortnightly runs during the next two months. The first run has already taken place, and the next one will be on May 19. The tour will be to West Point. On June 2 the members intend to make a trip to Philadelphia and return. On June 15 the tour will be to Bernardsville and on June 30 to Asbury Park. There is some talk of a floral automobile parade in connection with this run, similar to that of the wheeling parade which was held at Asbury Park two years ago.

TRAIN LIGHTING.—Prof. Geo. D. Shepardson, of the University of Minnesota, read a paper on "Train Lighting" before the Northwest Railway Club at the Ryan Hotel, St. Paul, May 8. Elaborate tests have been made under his direction of the illumination in a large number of street cars and railway coaches. These results have been plotted so that the curves show the intensity of the light in candle-feet at different points in the car. The positions of the lights are also shown on the curves. The paper also dealt with the comparative costs of oil, gas and electric lighting.

THE CHAMBLY POWER COMPANY proposes to build a second dam across the Richelieu River, Que., about two miles above the present dam. This new work will serve the double purpose of preventing the occasional formation of frazil, or anchor ice at the lower dam, and will likewise furnish about 10,000 additional horse power for transmission to Montreal. It is expected that the Montreal Electric Street Railway will take a part of this new supply of power. At present, at certain hours of the day, the demand for lighting and manufacturing purposes takes about all the current which the com-

pany transmits to Montreal, but at other hours much of the energy is unused. It is now proposed to store the surplus power in storage batteries and draw upon it in the hours of greatest demand.

STORAGE BATTERY CHARGING SYSTEM.—In a patent issued May 1 to Lamar Lyndon, a system is described for charging storage batteries from a consumption circuit, the charging voltage being kept constant notwithstanding variations of e. m. f. on the lines. To this end a booster in the charging circuit is driven by a shunt motor which is provided with an auxiliary winding connected in series with the consumption circuit and receiving the current passing to the consumption devices. On increase of current in the consumption circuit, the field magnetization of the motor is increased, thus causing it to run slower, and thereby reducing the booster e. m. f. On the other hand, a decrease of consumption e. m. f. decreases the current in the motor coils, thereby causing it to run faster and thus increase the booster e. m. f.

UNITED STATES STANDARDIZATION BUREAU.—The Committee of Coinage, Weights and Measures of the House of Representatives gave a hearing last week on the proposed measure establishing a United States Standardization Bureau. Among those who appeared before the committee to advocate the measure were Dr. Kennelly, president of the American Institute of Electrical Engineers; Captain Sigsbee, representing the Navy; Dr. McMurtrie, representing the American Chemical Society; Dr. Pritchett, of the United States Coast and Geodetic Survey; H. I. Cobb, of the United States Supervising Architect's Office, and Secretary Gage. The American Institute of Electrical Engineers presented a committee endorsing the measure. At the conclusion of the hearing, the committee unanimously agreed to report the bill to the House as an amendment to the Sundry Civil Service bill.

THE USE OF METERS.—An interesting case was recently decided by Judge Butler at Media, Pa., involving the use of meters. Suit was brought against the Media Electric Light Company by one of its customers who requested it to furnish him with current at the same rate as that furnished to other users. He had a meter in his house, but found that the cost was greater than by the ordinary contract in force, and demanded that the meter be taken out and that he be furnished light at the old rate. This the company refused to do, having adopted a rule to use meters in cases where new contracts were made. The customer, Mr. Mercur, claimed that this was a discrimination and that the company had no right to make one person use a meter and furnish current to another under contract at a less rate. The court took this view of the matter and ordered a mandamus to issue requiring the company to furnish light to Mr. Mercur at the same price as it charged others.

STRIKES.—The labor world throughout the country, especially east of the Mississippi, is greatly disturbed at the present time. On May 1 there was a general labor movement in various parts of the country, resulting in strikes, many of which involved electrical work. In Rochester, N. Y., nearly 100 electrical workers struck for an eight-hour day, but their employers are resisting their demands. In Springfield, Mass., all of the telephone linemen in the employ of the New England Telephone & Telegraph Company went on a strike. In Philadelphia, 400 electrical workers are out, tieing up twenty-eight shops. In Buffalo, N. Y., 150 linemen and instrument fitters, employed by the Bell Telephone Company, asked for an increase in wages and a shorter day. Their demands not being granted promptly, a strike resulted. In New York City the strike of electrical workers is still in progress. It is stated that employers are signing the union's agreement, and the strikers are confident of success. Over 600 union men are still idle. Nearly 19,000 men struck in various parts of the country on the date mentioned.

SEPARATION OF SILICON.—In a patent granted to R. I. Knaur, H. W. Buck and C. B. Jacobs, a process is described for separating silicon from silicious materials and the formation of silicon hydride by permitting a hydrogen-bearing gas to act upon a silicious material brought to a state of fusion or incandescence. The silicon hydride may then be acted upon subsequently for the reduction of silicon or for the formation of other products; and in case the raw material used contains materials other than silicious, the product freed of silicon may be utilized. In carrying out the invention, for raw material any silicious compound containing silicic oxide alone or combined with other materials, may be used. This material is brought to a state of fusion or incandescence by the application of heat, after which there is admitted to the mass or liberated within the same, a hydrogen-bearing gas such, for example, as water gas or other gas containing hydrogen in association with an oxide of carbon—thereby permitting the hydrogen to react upon the silicious material and form silicon hydrid. The operation is conducted in an electric furnace, the arc being at the surface of the material.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—The New York delegation to the National Electric Light Association Convention at Chicago on May 22, 23 and 24, will leave New York via the Pennsylvania Railroad at 1:55 p. m., Sunday, May 20, arriving at Chicago at 5 p. m. the following day. In last issue a partial list was given of the papers to be read at the convention. In addition to those mentioned are the following: "Exhaust Steam Heating," by Col. F. A. Copeland and Harry J. Frith; "Combination Electric Lighting, Power and Railway Work," by R. S. Feicht; "Automobiles as a Source of Revenue to Central Stations," by Elmer A. Sperry, and "Alternating Current Generators," by H. G. Reist. The topic "Free Wiring" will be discussed, as well as the question of municipal ownership of electric lighting. At Chicago the local reception and entertainment committee has arranged for a general reception at the Auditorium Parlors on Monday evening, May 21; for an automobile ride for the ladies on Tuesday morning, with luncheon at the Washington Park Club; on Wednesday, a shopping tour in the morning and a matinee in the afternoon; on Thursday, the Art Institute and Public Library will be visited in the morning, and a matinee in the afternoon. The headquarters of the association will be at the Auditorium Hotel.

ELECTRICAL RESISTANCE.—In November, 1897, a patent was issued to J. F. Bachmann and Adolph Vogt, of Vienna, describing an electrical resistance consisting of artificial stone compound formed of a mixture of a conductor, such as carbon or metals, and a non-conductor, such as koalin or oxides. The material is prepared by mixing these substances together with water or other liquid in the form of a paste or dough and after molding or running the mixture into molds and drying, the resulting body is heated to a high temperature while it is either embedded in carbon powder or is surrounded by reducing gases. With resistance bodies so prepared it is of considerable importance on account of their low degree of conductivity that with a very small movement of the circuit-closing devices employed, comparatively large surfaces of the resistance body shall be included in or excluded from the circuit. In a patent issued May 1, means for accomplishing this purpose is described, which consists of forming the resistance body in the form of a plate or slab, the circuit-closing device having also a plate form and extending across the entire width of the resistance body. By this means a comparatively small motion of one of the plates, a regulation between wide limits is obtained.

AN AUTOMATIC VOLTAGE REGULATOR FOR ALTERNATORS.—Mr. E. M. Hewlett describes and claims in two patents issued May 1, a device for automatically operating the field rheostats of alternating generators. The arrangement comprises the usual rheostat arm driven by a train of gears thrown into or out of operation or reversed by magnets which are in turn controlled by a relay excited by the alternating difference of potential generated by the machine. The patents describe an ingenious means of preventing sparking at the relay contacts by an auxiliary magnetic switch, short-circuiting the relay contacts and de-energized and opened only when the relay throws its tongue over to the back stop. For several alternators worked in parallel with each other one alternator is chosen as a master machine and the relay of each of the others is wound with two coils, one connected serially in the armature lead of the corresponding machine and the other in the corresponding lead of the master machine. In this way it is intended to make each machine give the same output as the master machine, the specifications claiming that the object is to cause a proper division of load between a plurality of generators connected in parallel with each other. If there is any truth in the commonly-accepted idea that the division of the load between alternators depends solely on the work done by their prime movers at the same speed, the system proposed by Mr. Hewlett will result in making the machines exchange leading and lagging currents to a sufficient extent to balance the differences between their energy outputs caused by the action of their governors.

RAILWAY MULTIPLE CONTROL SYSTEM.—In one system of multiple control for electric railway motors, a pilot motor is used on each car, controlled from a master controller located at any desired point on the train. One of the objects of a patent issued May 1, to Mr. M. T. A. Kubierschky, of Berlin, Germany, is to simplify such an organization and to reduce the number of train wires to operate the various controllers to a minimum. But two train conductors are required in this system to operate the pilot motors in both directions, and in case electric brakes are used, but two other conductors are required to brake in both directions. Each of the motor controllers is provided with an electromagnet for actuating a switch-locking device and an electromagnet for connecting the controlling cylinder to the pilot motor, the wiring of the two electromagnets being connected in series with each other. As soon as the master controller has been closed, the pilot motor begins to revolve and at the same time the two electromagnets are brought into operation. One of these electromagnets operates to move a gear along the shaft of the controller cylinder and into engagement with an intermittent gear driven by the pilot motor, and the controller cylinder is thus operated step by step at each revolution of the intermittent gear until it has been brought to its final position. This electromagnet also serves to close the main controller circuit. As soon as the pilot motor circuit is closed, the second magnet locks the controller in one direction. When the main circuit is opened, the controller cylinder is unlocked and brought to its off position by means of an actuating spring.

COMPOUNDING BALANCERS FOR THREE-WIRE SYSTEMS.—Many arrangements of field windings have been proposed for use on motor generators consisting of two motors coupled together and connected in series with each other to balance a three-wire system. If the motors are plain shunt machines and one side of the system becomes more heavily loaded than the other, the machine on the loaded side will work as a generator, the other one running as a motor, and, owing to the resistance and field reaction of the armature, the voltage of the machine on the more heavily loaded side will fall; while to obtain proper balance it should rise in order to compensate for feeder and line drop. To overcome this difficulty it has been hitherto proposed to make each machine excite the field of the other or to put a compound coil on each excited by the current coming in through the neutral. The simplest and most obvious arrangement seems to have been hitherto overlooked and has been claimed by W. L. R. Emmet in a patent issued May 1. The two balancing machines are compound wound, the series coil of the one on the positive side of the system being connected in series with the positive outgoing feeder, the series coil of the negative machine being connected correspondingly in series with the negative outgoing feeder, so that these coils carry current equal or proportional to the loads on their respective sides of the system. If the positive side becomes more heavily loaded than the negative, the positive balancer becomes more strongly excited than the negative, and—since the two must run at the same speed—gives a higher e. m. f. than the negative, thus compensating for the neutral drop as well as for the greater feeder drop in the positive than in the negative line.

LETTERS TO THE EDITORS.

The Hannawa Falls Power Plant.

To the Editors of Electrical World and Engineer:

Sirs:—I read with much interest the account in your issue of April 28 of the destruction of the Hannawa Falls power plant, and as I was on the scene a short time after the accident, some further details may interest your readers.

The accident was primarily caused by the breaking away of a bank of earth at the head of the canal which kept the water out of the canal until the head gates were placed. The high water burst through this bank and entered the canal in a great wave. When it reached the forebay it struck with tremendous force, and soon after burst through at the junction of the forebay masonry wall and the earth embankment, tearing out part of the wall and about 50 feet of the earth embankment, hurling it upon the power house 80 feet below, and partially destroying it. The power house was not completed, the walls being up about 20 feet. The water took out the north and south walls and about 150 feet of the west wall.

The plant was not injured to the extent stated in your columns, the loss being estimated at $15,000 at the outside. The dynamos were not installed, and being in a safe place, were not injured; nor was the surrounding country flooded, as stated. The plant when completed will develop 25,000 horse-power instead of 12,000 horse-power, as stated.

CHAS. H. LAWRANCE.

POTSDAM, N. Y.

A. I. E. E. Election.

To the Editors of Electrical World and Engineer:

Sirs:—With your kind permission I will say a few words in your columns regarding the coming election of officers for the American Institute of Electrical Engineers.

I have been informed that a number of associate members and others feel that there is danger that action may be taken limiting the present rights of associate members unless at this time a suitable protest is made. Accordingly, they have asked that my name be substituted for that of Dr. Cary T. Hutchinson for manager. The importance of the issue thus raised has prevented me from withdrawing my name from a candidacy not sought by me, and which if based upon personal considerations, would be distasteful to me for many reasons, not the least of which is the high regard which I have for Dr. Hutchinson.

I have been informed that owing to the use of my name as a candidate for manager, some have the idea that I am opposed to the election of Dr. Pupin for president. Such is not the case, and it is to avoid being placed in a false position in this matter that I have troubled you with this correspondence. Dr. Pupin was my choice for president from the beginning, and I voted for him because of my knowledge of his valuable scientific achievements and excellent personal qualities. In thus testifying my admiration for Dr. Pupin, I do not wish in any way to reflect upon the other candidates prominently mentioned, for I believe that under the administration of any of them the Institute would continue in its career of usefulness.

NEW YORK. JOHN J. CARTY.

Armature Reaction of Alternators.

To the Editors of Electrical World and Engineer:

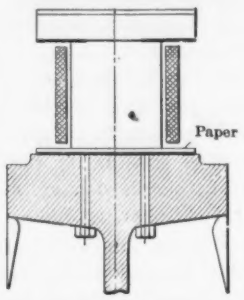
Sirs:—I have read with much interest the editorials in your issue of April 7 and 28 on the design of alternators for large outputs. Though agreeing almost entirely with the whole tenor of these editorials, yet I think that exception should be taken to several rather dubious statements in them, which doubtless are owing merely to the limited space allowable and consequent danger of ambiguity in treating an abstruse and complex problem.

When referring, in the case of a particular machine, to the increase of the no-load exciting current to maintain normal voltage with full load, the statement is made that "this increase exists in spite of an air-gap of ¾ of an inch, and is directly due to the high speed of rotation and consequent easily attainable high peripheral speed as compared with most engine-driven units. This high speed with the low frequency of 25 cycles requires poles spaced a wide distance apart, giving a great many armature turns per pole and consequently a high armature reaction. The same comparative high-pole speed gives the machines many and great advantages that much more than compensate for this slight disadvantage, which indeed is of academic rather than practical importance."

In larger generators large variations in exciting current may be permissible, though as far as regulation is concerned it is not desirable. The argument constantly advanced against those who advocate a smaller drop is that the conditions which create a large drop prevent a disastrous effect of a short-circuit. Granted, but who has ever heard such an argument about direct-current generators? Let us be under no delusions, then. We make machines with a large drop because they are cheaper and can, at present, hold their own in the market; and to justify such procedure, we eke out the advantages of the larger drop, of which, in my opinion also, there are really some. Put to the commonsense of the engineer, we may say that in order to gain one advantage we have to sacrifice another and eventually to strike a balance between the two. Now, the unpleasant thing is that into this operation of striking a balance there enters a subjective factor, our "personal equation," as astronomers call it; hence, though

scientific questions are mostly questions of evidence, technical questions are often matters of opinion.

After this somewhat philosophical divagation I may proceed to find fault with the first and second sentences quoted. It is obvious that a large pole-pitch implies—if the number of ampere turns in the armature per inch circumference remains the same—that, absolutely, the armature reaction is proportional to the pole-pitch. I



METHOD OF INCREASING MAGNETIC RELUCTANCE.

may remark in passing that this is true only with some qualifications, as the leakage increases, as it were, the armature-reaction for small pole-pitches; but I treated this subject at much length in the columns of this paper two months ago, and I need not therefore enter upon it here. But as the number of ampere-turns that may be placed upon the field magnets is also proportional to the pole-pitch, the sentence that "this high speed with the low frequency of 25 cycles requires poles spaced a wide distance apart, giving a great many armature turns per pole and consequently a high armature reaction," is apt to be greatly misunderstood. The compensation of the armature reaction requires a high reluctance of the main magnetic circuit, which can be obtained by the combined effect of a high saturation, a comparatively large air-gap, and, if this is not sufficient, the magnetic reluctance can be increased by putting paper between the poles and the yokes, as the annexed sketch illustrates. This has the great advantage of increasing the magnetic reluctance of the main circuit without increasing the leakage as much as a wider air-gap would do.

I am not of the opinion that a small drop is merely of academic importance, but let us leave matters of opinion aside. But the passage of the editorial quoted by me awakens the impression as though a "comparative high-pole speed" and "poles spaced a wide distance apart," cause a "high armature reaction." If this is the meaning of the passage, it is not in accordance with fact and observation, nor with the simple considerations alluded to above. As a matter of fact, the greater the pole-pitch the smaller the drop, is true within very wide limits, and this seems to be the view of the writer in the issue of April 7. For a *given* drop the best pole-pitch is determined by commercial considerations.

In conclusion, I wish to say again that the points of difference to which I have given prominence here are few in comparison with the many points of perfect agreement. B. A. BEHREND.

ERIE, PA., May 3, 1900.

[The words "academic importance" were intended to apply merely to the watt expenditure in the excitation and not, as the complete sentence seems to imply, to armature reaction.—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous Converters.—Three communications, illustrated by diagrams showing that in a converter with two windings on a single core, the relative direction of winding of the primary and secondary is of no importance for good working of the converter. Some practical reasons why they might be wound in opposite directions are given, such as that the polarity of the terminals on one side of the machine is then the same in both armatures.—Lond. *Elec. Eng.*, Apr. 13.

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Drop of Voltage in the Armature of Alternators.—BEHREND.—A long illustrated French abstract of the German article noticed in the Digest, Dec. 23.—*L'Eclairage Elec.*, Feb. 24.

Synchronous Motors.—EICHBERG.—A brief abstract of a paper read before the Electrotechnical Society of Vienna, on the theory of synchronous motors, especially on the influence of the resistance and reactance of the line upon the motors.—*Zeit. fuer Elek.*, Apr. 8.

The Short Circuit Curve of Alternating-Current Generators.—ROTHERT.—A long, illustrated French abstract of the German article noticed in the Digest Sept. 30, Oct. 7.—*L'Eclairage Elec.*, Feb. 24.

Foundations for Electrical Machinery.—PANAMOLO.—An illustrated article on the proper materials and design for the construction of the foundations.—*West. Elec.*, Apr. 28.

LIGHTS AND LIGHTING.

Lighting by Gas and Electricity.—DE SEGUNDO.—An article in which he reaches the following conclusions: It is practically impossible to define a basis for comparison which shall be applicable to each and every form of gas and electric lighting. If the ordinary 5-ft. gas burner is compared with the 16-cp incandescent lamp for domestic lighting, then "on the basis of light for light only," gas at 75 cents per 1000 is equivalent to 6½ cents per kilowatt hour; but "when the saving effected by the use of the electric light is taken into account, together with other material advantages," it is possible that electricity at 8 cents per kilowatt hour will commercially be equivalent to gas at 75 cents per 1000. Lighting by incandescent gas is cheaper than by electric incandescent lamps. Arc lighting is cheaper than any form of ordinary gas lighting or incandescent gas lighting. Some forms of intensified gas incandescent lighting bid fair to compete with arc lighting, but their practical utility is not yet sufficiently demonstrated.—Lond. *Elec. Rev.*, Apr. 13, 20.

Lighting of Cars.—A brief description of a system devised by Vicarino and used by a company in Nancy. A dynamo is driven from an axle of the car and a battery is used; the necessary automatic devices which would distinguish this from similar systems are not described. A railway car has generally 8 to 10 lamps, each of 10 candles. The voltage is 30. The battery of 16 cells has a capacity of 40 or 60 ampere hours. The cost of operation of a 10-cp lamp hour is 0.12 cent, of which 0.05 is for motive power, 0.01 for lubricating, 0.04 for the maintenance of the battery, and 0.02 for the renewal of the lamps. For comparisons 0.9 cent is given as the cost per 6-cp lamp hour with oil lighting, 0.7 cent per 10-cp lamp hour for gas, 0.68 cent per 10-cp lamp hour with a pure accumulator system, 0.5 cent per 10-cp lamp hour with acetylene. The cost of operation of a car, lighted four hours per day, is $52.56 with oil, $40.88 with gas, $58.40 with a pure accumulator system, and $14 with the Vicarino system. The cost of the first installation is $40 for oil, $160 for gas without counting the expenses of the plant and the piping, $190 for a pure accumulator system, and $250 for the Vicarno system.—*La Nature*, Apr. 7.

REFERENCES.

Arc Lamps.—The discussion in full, which was held before the Int. Soc. of Elec. in Paris, abstracts of which were noticed in the Digest, Apr. 7.—*Bull. de la Soc. Int. des Elec.*, February.

Theatre Lighting.—An illustrated article on the system of theatre lighting, used by Richter, Weil & Co. The arrangement of the incandescent lamps is described.—*Elek. Rund.*, Apr. 1.

POWER.

Electric Riveting Machinery.—KODOLITSCH.—An illustrated description of two types of electric riveting machines, one stationary and the other portable, the weight of the latter being about half a ton. The power developed by an electric motor is used directly for closing the rivets. A heavy disc is always kept rotating by the motor, whether the riveter is closing rivets or not; it can become, at the same time, an electro-magnetic coupling, so that when the current is passing this coupling, a second disc, keyed on to a screw

spindle, may be quickly and firmly attached to the revolving disc; the friction of the screw spindle can thus be regulated as desired. The screw spindle moves a large nut at the end of a knuckle joint or lever, which raises and lowers the die for making the rivet head. When the rivet is put into position, the operator places one die on the existing rivet head and presses a button, allowing the current to pass through the coil of the electromagnetic coupling, so that the screw spindle is revolved. There is an automatic cut-out arrangement by means of which the two discs are disconnected before the end of the travel of the nut. The air blast for a small rivet-heating furnace is supplied by an electrically-driven blower, the motor of which is of ⅙ horse-power, and the quantity of rivets heated by such a blower is sufficient to supply two riveting machines, i. e., about 3000 rivets per day.—*Cassier's Mag.*, May.

Speed Regulator.—An illustrated description of a speed regulator, devised by Gime, consisting essentially of a varying element, interposed between the prime mover and the machine to be controlled, and of a Watt ball governor acting on a power transmitter, through an intermediate mechanical arrangement, in such a way as to diminish the speed when the driving axle speed increases, and vice versa. The mechanism is described in detail and illustrated.—*La Vie Scientifique, El'ty,* May 2.

Traction.

Charging for Electrical Energy for Tramways.—A statistical article giving the price per kw-hour, charged to the municipalities owning the tramways, for current supplied for traction by the lighting companies. It is 1.8c. in Liverpool, the number of units supplied to the tramways during 1899 being 1,883,728, so that the lighting department had an income of $34,000; the cost of the horses which had previously worked the tramways, came out at $700,000 per year. In Bradford the charge is 2c. per kw-hour, in Bolton 3c., in Halifax 3.76c.; at Aberdeen the energy is supplied to the tramways at cost price, in which price all interest charges and sinking fund as well as working expenses are to be included. At St. Helens a sliding scale has been arranged, the average being about 3c. At Plymouth for all current up to 150,000-kw hours per year a charge of 7c. per unit is made; for the excess beyond this up to 500,000 units 4.6c. per unit is to be paid; in this case the cost of the feeders to supply the trolley wire is borne by the lighting department, and the tramway department is not charged for the expenses and remuneration of the superintendent of its department. In all these cases the electric tramways and lighting are owned by the municipal authorities. In Dover the electric lighting is in the hands of a company, the tramways are municipal and guarantee to purchase a minimum of 160,000 kw-hours per year, the price to be 6c. per unit for all up to 240,000; if this amount is exceeded and the total consumption is below 360,000 units, the price is reduced to 5.5c. per unit for the whole quantity; if the quantity exceeds 360,000 units per year, it is all charged at the rate of 5c. per unit.—Lond. *Elec. Eng.*, Apr. 20.

Automobiles.—An article giving a comparison of the cost of driving carriages by horses, by benzine motors and by electric motors. In these three cases the first cost of installation is $700, $1500, $1500, respectively, and the cost of operation per day $3.41, $4.06, $3.19. Some newer types of electric automobiles of German manufacture are illustrated.—*Elek. Anz.*, Mar. 29.

References.

Johnson-Lundell Electric Traction Plant.—An illustrated description of this system, which is soon to be put on the market in England, and which has already been fully described in American journals.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Apr. 20.

Traction Motor Suspension.—E. K. Scott.—The first part of an illustrated article, dealing with geared motors. He gives brief illustrated descriptions of the Sperry suspension with bevel wheels, the wheelbarrow suspension, nose suspensions, the side-bar suspension, the yoke suspension of the General Electric Company, the Schuckert suspension, the top-bar suspension, the cradle suspension and the Walker double-spring suspension.—Lond. *Elec. Rev.*, Apr. 13.

Automobile Exhibition.—A brief article on the exhibition of the latest types of automobiles at Islington, England. The electric automobiles exhibited are very briefly described. Most of the oil-motor vehicles are fitted with electric ignition devices.—Lond *Elec.*, Apr. 20.

Automobile Accumulators.—Bainville.—The concluding articles of his very long serial on the competitive tests of the accumulators of the Automobile Club of France (Digest Jan. 20, Mar. 3). He discusses some defects in the programme of these tests and shows that nevertheless these tests have given some characteristic coefficients of the batteries, which are important in practice. A summary of the main results of the tests is given (see Digest Feb. 10).—*L'Elec.*, Mar. 17, Apr. 7.

Automobile Accumulators.—Bainville.—Continuations of the illustrated description of the accumulators which were entered in the recent Paris tests (Digest, Mar. 10): Accumulator of the Society of Electrolytic Sodaworks, Titan accumulator, *L'Eclairage Elec.*, Feb. 24; Lagarde, Tudor, Hathaway, Wueste and Ruppecht accumulators, *L'Eclairage Elec.*, Mar. 3.

Stanstad Engelberg Railway.—The first part of an illustrated description of this railway, which is one of the latest examples in which polyphase currents have been successfully used for traction work in Switzerland. The line in its construction and working closely resembles a line of standard gage, as noticed previously in the Digest.—Lond. *Elec. Eng.*, Apr. 13.

Dublin.—The first part of a long, illustrated description of the power-house of the Dublin electric tramways. There are five generating sets, each consisting of a 550-kw railway generator.—Lond. *Elec. Rev.*, Apr. 20.

Hauling Freight.—An illustrated article on the "theory and practice" of hauling freight and express matter on electric railways.—*St. R'y Rev.*, Apr. 15.

Testing Rail Bonding.—Herrick.—A communication criticising the proposals of Nissley (Digest, Mar. 31).—*St. R'y Rev.*, April.

Eddy Current Brake for Tramways.—An illustrated French abstract of the German article noticed in the Digest, Dec. 30.—*L'Eclairage Elec.*, Mar. 3.

Electric and Cable Railways.—An article on the working expenses of electric and cable railways. Statistical tables are given for the Liverpool overhead electric railway, the City and South London electric railway, and the Glasgow district subway, which is operated by cable.—*Tramw. and Ry. World;* Lond. *Elec. Rev.*, Apr. 20.

Installations, Systems and Appliances.

Maximum Demand Indicator.—An illustrated description of a very simple indicator, devised by Rimington, to be used in connection with an electrolytic meter. The action of the indicator is not directly electrical, but consists in utilizing the pressure of the escaping gases evolved in the electrolytic house meter. As a consequence, no electrical energy is consumed by the indicator. It consists of an U tube, the lower part of which is filled with a liquid. The upper end of one limb is connected through a flexible tube to the electrolytic meter so that the gases evolved are carried off through this tube. Attached to the upper end of this limb there is a porous plug, through which the gases escape at a certain rate. When the current passes through the meter, the rate at which gas is evolved is proportional to the current; for every definite current a definite pressure is produced, proportional to the current; it causes the liquid to move down in the first limb of the U tube and to rise in the second limb, which has at its upper end a porous plug, acting as a damper, and is also connected at its upper end to a vertical tube, into which the overflowing liquid flows from the second limb of the U tube. The height of the liquid in the third vertical tube is read on a scale which gives directly the maximum current that has flown through the meter. The indicator is said to be reliable in practice.—Lond. *Elec., Elec. Eng.*, Apr. 20.

Electric Equipment of Warships.—Grove.—A continuation of his illustrated paper (Digest, Apr. 28, May 5). He deals with the problem of maintaining communication between the several compartments, which, however, is not yet successfully solved. A naval telephone which is largely used is Alfred Graham's; it is a loud-speaking instrument, the transmitter taking the current of four or six large agglomerate Leclanche cells, and operating without an induction coil; the transmitter is of granular type, enclosed in a watertight case; it is turned half around every time the telephone is used, by the switch which puts the line connections from ringing to speaking. What is wanted, is a system of printing telegraphs, the instruments of which are not too delicate. Electricity is always used for discharging torpedoes and for firing modern breech-loading guns of all sizes; while all other circuits in the ship are twin wired. gun and torpedo circuits are now universally single wired. Range finders are sometimes electrical; that used by the U. S. Navy, invented by Fiske, is based upon the Wheatstone bridge principle and is

illustrated and described; that used in the British Navy and invented by Barr and Stroud, is a purely optical instrument. Some British war vessels are provided with an electric system of engine-room reply telegraphs; the indicating instruments have the appearance common to mechanical telegraphs, the dials being marked to show the usual direction orders. The revolution of the indicating hand is effected by the combined operation of two electromagnets placed at right angles to one another, and producing between them a cross magnetic field, within which lies a magnet with which the indicating needle is geared. The position of the needle depends solely on the relative strength of these two field components and this depends on the ratio of the current in the two coils. This ratio is controlled by the "transmitter," which consists of a multiple contact switch, through which the ordinary 80-volt electric light circuit is connected to a pair of ratio arms included in the same circuit as the coils of the indicator; the movement of the transmitter switches resistance out of one arm into the other, thus altering the relative value of the current strength in them, and controlling the movements of the indicator. The action does not depend on the absolute value of the currents in the indicator coils, but only upon their relative value, so that a constant voltage is unnecessary. A similar indicating instrument graduated in degrees, is used for showing, at the several navigating stations, the angle made by the rudder, the transmitter switch in this case being systematically worked from the rudder crosshead. A system for showing simultaneously in the bridge positions, conning towers and other navigating stations, the revolutions of each set of engines, and for indicating in each engine-room the revolutions made, not only by the set of engines in that room, but also by the set in the other room, is also described; it has been devised by Molinari and is used in the Italian navy and also on warships of other countries.—Lond. *Elec. Rev., Elec. Eng.*, Apr. 20; the first part of the paper also in Lond. *Elec.*, Apr. 20.

Switch Gear.—An illustration and brief description of the Lucas switch gear, in which the multiple contacts are placed on the base with their faces in a vertical plane, so that much less space is taken up than when these contacts are mounted flat on the base itself. The contact lever is so arranged that its axis can be conveniently extended in order that a number of switches can be worked in one line. Two series of contacts on the same switch can be so placed that first one and then the other is operated, so that a large number of contacts or steps in regulation can be obained in a small space.—Lond. *Elec. Eng.*, Apr. 13.

Central Stations and Isolated Plants.—ADAMS.—An article in which he shows that the main reason for much of the inability of a central station to compete with the electric isolated plant, is that the heat from exhaust steam in isolated plants can be utilized, so that the energy sold per ton of coal consumed is claimed to be multiplied several times. At electric generating stations two methods are in limited use for the distribution of the heat from engine exhaust: According to one plan, the exhaust steam is discharged into a pipe system extending over the area to be served, the practicable radius of operation of which seems to be limited to several hundred feet from the power station; another method is to use the exhaust steam to heat water and then to pump the hot water through pipes that make a complete circuit between the station and the service points; this system may be carried on profitably at a distance of half a mile and possibly at one mile from the generating plant. These methods are impracticable with the present large generating stations on account of the tendency to remove them far from the service areas. He then advocates the erection of electric generating stations driven by gas engines, in crowded areas, by reason of the relatively small amount of room that they require. Owing to the ease with which gas is transmitted by pipes, the plant for its production may be located where all of the possible economies as to transportation, water and labor, may be practiced, and such a plant may supply electric generating stations over a very large area. The efficiency of gas engines which, it is claimed, enables from one-third to two-thirds more electric energy to be obtained for the same coal consumption, than the steam engine with its efficiency of 15 per cent. For gas engines of medium size the distribution of heat may be fairly taken as: delivered work 20 per cent, conduction and radiation 10 per cent, jacket water 40 per cent and exhaust-gases 30 per cent of the total heat produced by the gas consumed. The temperature of the jacket water is about 150° F., that of the exhaust gases 700° F. These hot exhaust-gases can readily be used to raise the temperature of the water from the cylinder jacket to 212 degs., or even a higher point, and thus fit the water for heating purposes as well as can be done with exhaust steam. With gas that contains 80 per cent of the energy in the coal, the jacket-water and exhaust-gases contain 56 per cent of the heat of the coal, or about 10 per cent less than the exhaust steam.—*Cassier's Mag.*, May.

Private Plant.—A well-illustrated description of the electric power plant of Armour & Co., in Chicago. Alternating current is generated at 1100 volts, transformed to 110 volts, and supplied to 300 enclosed arc lamps and 10,000 incandescent lamps; and continuous current at 500 volts for 120 motors at various points on the grounds and for the narrow-gage electric trolley railway, which is used for the transportation of meat between the building. The motors aggregate over 4000 horse-power and range in size from 1 to 200 horse-power. —*West Elec.*, Apr. 28; more briefly and with less illustrations in *Elec. Rev.*, Apr. 25.

Central Electric Supply Company.—An article on this English company, which has to provide two older companies with power, as their present stations are too small. It is proposed to install two 6000-volt, three-phase generators of about 780 kilowatts output each, and six 6000-volt, three-phase induction motors, coupled direct to 450-volt, continuous-current generators of about 260 kilowatts capacity each. The dynamos generate high-tension, three-phase current, which is transformed by the motor generators, placed two in the power house itself and two each in two sub-stations, into continuous current of 400 to 450 volts' pressure, so that it can be distributed from the existing continuous-current, low-tension switchboard at the several stations.—Lond. *Elec. Eng.*, Apr. 20.

REFERENCES.

Quarter-Phase versus Single-Phase System.—A long illustrated French abstract of the German article noticed in the Digest Jan. 6.—*L'Eclairage Elec.*, Mar. 10.

Motor Alternator and Battery in an Alternating Current Plant.—Two communications, illustrated by diagrams, discussing some cases in which a motor alternator in conjunction with an accumulator battery may be used to advantage in an alternating current station. The connections of the circuits are given.—Lond. *Elec. Eng.*, Apr. 13.

Interrupters.—An illustrated description of a recently patented automatic interrupter of the Helios Company for electric tramways and power transmissions. Destructive sparks are prevented by a resistance which is inserted. An electromagnetic device is used, by which it is made impossible to close the circuit as long as there is a short-circuit or too large a current.—*Elek. Anz.*, Apr. 5.

Switches.—LENNER.—An illustrated article on an improvement in switches for private lighting installations, by which either one of two lamps or groups of lamps may be switched on, but not both. The improvement consists in a device by which fraud is prevented.—*Zeit. fuer. Beleucht.*, Mar. 30.

Zuerich.—GUILLAUME.—An illustrated article on recent extensions of the power plant of Zuerich. The alternating-current central station in Letten and the motor-generator sub-station for supplying continuous current to the tramways are described.—*L'Eclairage Elec.*, Feb. 24.

Circuit Breakers.—VEDOVELLI.—The illustrated paper in full, abstracts of which were noticed in the Digest Apr.7.—*Bull. de la Soc. Int. des Elec.*, February.

WIRES, WIRING AND CONDUITS.

India Rubber.—HENRY.—An article on india-rubber for cable insulation in America, criticizing unfavorably the article of Schaefer, noticed in the Digest, Feb. 17. Against the statement that strong elastic rubbers, like pure para, cannot be pressed through a seamless machine unless heated to such an extent that they perish, he says that if that were so, the necessary heat for vulcanizing would always ruin it; the vulcanizing point as used on American cables is about 280° F., while the temperature of the steam jacketed machines for insulating never reaches a point higher than 200° F. Lead as applied to cables, in American practice, is first melted and allowed to flow into a hydraulic cylinder; it is then cooled to a state in which it is just plastic, about 125° F.; it is then forced around the cable at a temperature also lower than the vulcanizing point, and cooled at once. He has a sample of seamless rubber insulation that has been under water for twenty-one years, and the dielectric is still in perfect condition. The compounding of india-rubber for insulating purposes is now well-nigh a fixed science. The seamless insulating machine is now used almost universally in America, government specifications call for such an insulated wire, and these specifica-

tions include a layer of pure Para rubbers without compound, 1-64 of an inch in thickness, surrounding the conductor. All vessels of the U. S. Navy, and the latest types of Japan and Russia, are entirely equipped with this form of insulation, also all cables protecting the harbors and connecting the fortifications on the Atlantic, Gulf and Pacific coasts; also the cable connecting Cuba with the United States during the war with Spain, and the cable used in the Philippines. As for underground lead-protected, rubber-insulated cables, there are now in New York City alone over 10,000 miles.—*India Rubber World*, May 1.

Graphical Theory.—Hanappe.—A continuation of the article noticed in the Digest Mar. 24, giving a comparison of the quantity of copper necessary for the line in the principal continuous, single-phase and polyphase-current systems. The power transmitted, the length of the line and the loss by Joulean heat are supposed to be equal in all cases; in the first part of the article the maximum voltages to which the insulation of the lines is submitted, in the second part the e. m. fs. at the receiving end are equal; *i. e.*, the first part deals with long-distance, high-pressure transmissions; the second with power distribution at the ordinary voltage of the receiving circuit. These two cases are dealt with for nine different systems and the results are given in a table, as follows:

Continuous current with two wires.....	100	100
" " with three wires.....	125	31.25
Alternating current with two wires.....	200	100
" " with three wires.....	250	31.25
Two-phase current with four wires.....	200	100
" " with three wires.....	291.4	72.9
Three-phase current, star connected without neutral wire	150	25
" " star connected, with neutral wire	175	29.2
" " ring connected	150	75

The numbers in this table give the quantity of copper, necessary for each system, if that for the continuous-current system with two wires is assumed to be 100; if the same power is transmitted over the same length of line with the same loss of power by Joulean effect; in the first column of numbers the maximum voltage between the wires is supposed to be equal, in the second column the effective voltage at the receiving end.—*L'Eclairage Elec.*, Feb. 24.

REFERENCES.

Wiring.—An article on some features in the arrangement and design of installation wires. The means of regulating the voltage are discussed, and equations are given for the determination of the cross section required in the single parts of the line in order to get the best economy.—*Elek. Anz.*, Apr. 1.

Glass Insulators for Industrial Lines.—Quantin.—An article in which he says that the glass insulator is the insulator of the future, all difficulties in its manufacture and use being now overcome.—*Bull. des Usines Elec.*, 24, p. 383, 1899; abstracted in *L'Eclairage Elec.*, Mar. 10.

Electro-Physics and Magnetism.

Roentgen Rays and Photographic Plates.—A note on a discovery made by Nipher. When photographic plates are exposed to the light of an ordinary room for a few days, they may still be used for taking Roentgen ray pictures. If, while the Crookes tube is acting on the plates, they are still exposed to the ordinary light of the room, they develop as positives. The shadows are dark. If they are in a plateholder when exposed to the Roentgen rays, the pictures are like those formed in the ordinary ray, and they are apparently as clearly defined.—*Science*, Apr. 27.

Absorption of Light by Glowing Gas.—Cantor.—A description of an experiment showing that Kirchhoff's law, according to which the ratio of the emission of a gas to its absorption is constant and equal to the emission of an absolutely black body at the same temperature, does not apply to electrically-glowing gases in a vacuum tube. He sent a strong beam of light through a vacuum tube from end to end and back, and compared its intensity with a beam passing through air under normal pressure. He found that the beam of light suffered no absorption in the electrically-glowing gas. There is emission, practically without absorption, and the light-yielding mechanism appears to be of a totally different nature from that of ordinary flames.—*Ann. der Physik.*, No. 3; abstracted in Lond. *Elec.*, Apr. 13.

REFERENCES.

Diffusion of Cathode Rays.—Kaufmann.—An illustrated French abstract of the German article noticed in the Digest Oct. 21, Nov. 18.—*L'Eclairage Elec.*, Mar. 3.

Diffraction of Roentgen Rays.—Maier.—A French abstract of the German paper noticed in the Digest Sept. 16.—*L'Eclairage Elec.*, Mar. 3.

Condenser Discharges.—Richarz and Ziegler.—An illustrated account of an analysis of the discharges of a Leyden jar by means of a Braun cathode-ray tube and a revolving mirror.—*Ann. der Physik.* No. 3; abstracted in Lond. *Elec.*, Apr. 13.

Molecular Susceptibilities.—Liebknecht and Wills.—An illustrated account of an experimental investigation of the magnetic molecular susceptibility of salts of the iron group (see also Digest, Mar. 24).—*Phys. Rev.*, April.

Thermomagnetism.—Moreau.—Two French Academy notes, the first on Hall's phenomenon and the thermomagnetic currents, the second showing the differences between his theory and that of Voigt.—*L'Eclairage Elec.*, Jan. 27, Mar. 10.

Terrestrial Magnetism.—Bauer.—A paper, read before the Philosophical Society of Washington, on some recent contributions to terrestrial magnetism, giving an outline of the work of Schmidt, Eschenhagen and Bemmelen.—*Science*, Apr. 27.

Electro-Chemistry and Batteries.

Storage Battery Problems.—The conclusion of the long discussion which followed the paper of Wade (Digest, Apr. 14, 21). A summary is given in an editorial. Concerning the practical part of the paper, especially the importance of having a free circulation for the electrolyte and plenty of it, as well as a porous active material, there was unanimity; while in regard to the theory of the accumulator there was a great divergence of opinion. The foundation of Wade's theory is that in the cell there are not simple lead peroxide and lead sulphate alone, but more complex substances which contain both; there is an allotropic modification and polymerisation. With regard to the behavior of the negative plate, it is said that the evidence in favor of allotropy is not thoroughly convincing; it appears highly desirable that Darrieus' experiments should be repeated. In the case of the positive plate, the weight of evidence is said to lean in favor of those who hold with Wade that pure sulphate of lead is exceedingly difficult to reduce electrolytically, whereas the electrolytic sulphate is comparatively easy of reduction. Reference is made to the experiments of Peters with softened plates (Digest, Apr. 28).—Lond. *Elec.*, Apr. 20.

Lead Zinc Accumulator.—An illustrated description of a battery, in which the zinc has the form of an amalgamated plate coiled so as to fit snugly against the glass wall of the cell, and the lead electrode is composed of a great number of spongy, superposed peroxide plates suspended from the insulated cover of the cell. The voltage is 2.65 at full charge and 2 at the end of a discharge.—*Sc. Amer.*, Apr. 28.

REFERENCES.

Duplex Cylinder Cell.—An illustrated description of this cell, the merits of which lie in the hollow walls which are charged with a special depolarizing compound, not described, there being plenty of compound in the cylinder to take care of several zincs. The result of some tests are given in two diagrams and show the superiority of the duplex cylinder cell over the ordinary cylinder cell under the same conditions.—*Tel. Mag.*, April.

Soda and Chlorine.—Hobart.—A continuation of his article on the electrolytic production of soda and chlorine, noticed in the Digest Mar. 24. (The article should be read very cautiously, as it contains quite a number of errors.)—*Am. Elec.*, April.

Electrolytic Reduction.—Sonneborn.—A brief article on the electrolytic reduction of paranitro aniline.—*Zeit. fuer Elektrochemie*, April 12.

Decomposition of Copper.—An article on the Dumoulin process of precipitating copper by electrolysis and its practical application by the Electrical Copper Company, of Widness, England.—*L'Ind. Elec. Chim.*, 3, 55; abstracted in *Elektrochem. Zeit.*, April.

Reduction.—Haber and Schmidt.—A paper on the chemical processes in the electrolytic reduction of nitrobenzole.—*Zeit. fuer Phys. Chemie*, 32, p. 271; abstracted in *Zeit. fuer Elektrochemie*, Apr. 12.

Iron Alloys.—An article on the Heibling process for producing iron alloys in the electric furnace, which has so far found no application in practice.—*L'Ind. Elec. Chim.*, 3, 50; abstracted in *Elektrochem. Zeit.*, April.

Engraving by Electricity.—RIEDER.—A very long illustrated article on the process described in the Digest Jan. 13.—*Elektrochem. Zeit.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS

Wehnelt Interrupters Acting in Parallel.—RUHMER.—An account of experiments showing that several Wehnelt or Caldwell interrupters with anodes of different sizes connected in parallel, interrupt synchronously. He found the law that two or more interrupters connected in parallel are equivalent to one interrupter, the platinum surface (or cross-section of hole) of which is equal to the sum of the platinum surfaces (or cross-sections of holes). He gives theoretical reasons for this phenomenon. In order that interrupters connected in parallel do not interrupt synchronously, but with equal frequency, proper reactances are to be inserted into the interrupter branches, behind the distributing point, so that the ratio of the reactances is the reverse of the ratio of the surfaces of the respective active electrodes. With two interrupters connected in parallel this can easily be done by putting any reactance in each branch and adjusting one platinum anode. First a combination sound is heard besides those of both interrupters; by and by both interrupter sounds approach each other, and beats are heard, until eventually both sounds are equal.—*Phys. Zeit.*, Apr. 21.

Electric Brake Dynamometer.—GRAU.—An illustrated description. On the shaft of the machine a copper disc is mounted which rotates between the poles of an electromagnet of horse-shoe form, placed upon the shorter arm of a beam-balance, the longer arm of which carries an adjustable weight. If the electromagnet is excited and the disc rotates, eddy currents are induced in the disc and act as a brake. If the number of revolutions of the disc and the excitation of the magnet is constant, the braking force is constant and can be determined by bringing the scales into equilibrium with the aid of the adjustable weight. The braking force can be varied through wide ranges by means of the excitation of the magnet and by the variation of the distance of the poles.—*Elek. Zeit.*, Apr. 5.

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Measuring the Conductivity of Metals.—JAEGER and DISSELHORST.—A long French abstract of the German paper noticed in the Digest, March 3.—*L'Eclairage Elec.*, Mar. 3.

Measuring Instruments.—ARMAGNAT.—An article giving brief illustrated descriptions of new improvements, taken from patent specifications.—*L'Eclairage Elec.*, Mar. 10.

Return Currents of Tramways and Measurements of Terrestrial Magnetism.—EDLER.—A long, illustrated English abstract of the German paper noticed in the Digest April 7.—Lond. *Elec.*, Apr. 20.

Measuring Instruments for Three-Phase Currents.—ARNO.—An illustrated French translation in full of his Como Congress paper, abstracted in the Digest Nov. 4.—*L'Eclairage Elec.*, Mar. 10.

Measurement of Conductivity.—MORGAN.—An article describing three improvements of Kohlrausch's method of measuring conductivities.—*Jour. Am. Chem. Soc.*, 22, p. 1, 26; abstracted in *Zeit. fuer Elektrochemie*, Apr. 12.

Plotting Hysteresis Loops.—KALLIR.—An illustrated article on the use of Braun's cathode ray tube for that purpose (see also Digest Jan. 27, Apr. 14).—*Zeit. fuer Elek.*, Mar. 18.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Toll Lines.—CLAUSEN.—An article, illustrated by many diagrams, on the design of a certain special toll-line system, between a number of scattered towns with several branch lines. He treats the problem of "signaling simultaneously a large number of telephones connected to a pair of wires in bridge." He describes two methods for increasing the efficiency of instruments for connection in parallel; in one, the smallest amount of current is used at the caller's station in sounding his own bell; the magneto-generator and 1000-ohm ringer are connected in series, this being the position normally assumed by the signaling system with the exception that the generator winding is shunted out of circuit, thus leaving the ringer magnets alone connected across the line; when the caller intends to transmit a signal, a shunt circuit is established cutting out the 1000-ohm ringer to such a degree that only a very small portion of current passes through them, while the greater portion of the current generated passes out to line over the comparatively low resistance shunt coil. The other method is a modification of the first. Neither solves the problem of the particular toll lines in question. He then describes the solution adopted in practice for that purpose. The construction of the instrument was similar in most respects to the regular bridging type telephone, with the exception, however, that no specially powerful magneto-generator was required; one side of the magneto-generator is connected to earth and both sides of the line circuit are brought in connection with the automatic-generator shunt in such a way that when the magneto-generator is driven for the purpose of transmitting a call, the line wires are short-circuited and a current sent through the circuit over both line wires in parallel and through the annunciator drop at the switchboard to ground. The switchboard jack is of special construction, being normally short circuited. With this system and with each line wire, measuring, say, 2000 ohms, which would make a total of 4000 ohms for ordinary bridging signaling circuits, there is but one-fourth of this resistance to signal through by virtue of using both of the line wires in parallel, and there are no by-paths with the resultant division of currents, the line drop receiving practically all of the current generated. Another feature of the system is that no subscribers' bells are sounded while the switchboard operator is receiving an incoming call, and under no circumstances are the subscribers able to signal among themselves, this duty of signaling between the subscribers being placed with the operator. The system is described in detail and illustrated by diagrams.—*Tel. Mag.*, April.

Cerebotani Writing Telegraph.—An illustrated description. The receiving apparatus reproduces the same curves which are drawn at the transmitting end. It is based on a system of co-ordinates; the pen at the transmitting end acts on a small commutator which changes the direction of the current frequently; at the receiving end these currents rotate gear wheels in the same direction, which operate two racks at right angles to each other, which in turn determine the motion of the reproducing pen. Only a single wire is necessary. —*Cosmos*, Mar. 17.

Multiplex Telephony.—TOMMASI.—A description of a device for multiplex telephonic transmission. It is based upon the fact that a sound which is interrupted continually by interruptions which do not last more than one thirty-second second, is perceived by the human ear as a continuous sound. If therefore in a line between two telephones an interrupter is inserted which produces such short interruptions, the telephonic conversation is not disturbed. This interrupter switches the line successively on to the circuits of the various transmitters so that there is never more than one circuit closed on the line. As in similar telegraph systems a second similar and synchronous interrupter is inserted at the end of the line. A form of the apparatus which may be used for that purpose is described, but it appears that no experiments have yet been made.—*Cosmos*, Mar. 24.

REFERENCES.

Pollak-Virag Telegraph System.—STERN.—An illustrated paper, read before the Electrotechnical Society of Vienna on this system, which was described in the ELEC. WORLD AND ENG. July 15, and referred to repeatedly since.—*Zeit. fuer Elek.*, Apr. 8.

Printing Telegraph.—RAPS.—A long, well-illustrated paper read before the Electrotechnical Society of Berlin, describing different forms of printing telegraphs and stock tickers of Siemens & Halske. —*Elek. Zeit.*, Apr. 12.

Telephone Call Counter.—BRITT.—An illustrated communication describing a counter.—*Elek. Zeit.*, Apr. 12.

Railway Signals.—PFEIL.—An illustrated paper read before the Electrochemical Society of Munich, on electric operation of railway switches and electric railway signals.—*Elek. Anz.*, Mar. 22.

British Cable Schemes.—A brief outline of the history of the Pacific and Cape-Australia cable schemes.—Lond. *Elec. Rev.*, Apr. 13.

Oelwein.—An illustrated description of the telegraph plant of the Postal Telegraph Cable Co. at Oelwein, Iowa.—*Elec. Rev.*, Apr. 18.

Austria and Netherlands.—Two statistical articles on telegraphy and telephony in Austria and the Netherlands in 1898.—*Jour. Tel.*, Mar. 25.

MISCELLANEOUS.

Electric Resistance of the Human Body.—BERMBACH.—An article describing a simple method of measuring the resistance of the human body with a voltmeter, the current being supplied by an accumulator battery. If two wires, with a pressure of 30 volts between them, are

touched one with each finger, the resistance of three different persons was found to vary between 100,000 and 200,000 ohms. If the resistance of a person was measured at different voltages, different resistances were found: 57,600 ohms at 80 volts, 44,700 ohms at 100 volts, 24,600 ohms at 140 volts. At the same pressure the resistance decreases when the current flows through the body during a longer period. The main resistance of the human body is located in the skin.—*Elek. Anz.*, Mar. 29.

Smelting Iron Electrically.—A note stating that Swiss engineers labor under the disadvantage that practically the whole of the iron used has to be imported from other countries, which is due, not so much to the absence of iron ores within their boundaries as to the want of coal for reducing it. Now a scheme for the application of the electric furnace to the smelting of iron on a large scale is being developed by Mueller Landsmann in the Bernese Oberland, near Meiringen. A concession has been obtained from the State for the working of an outcrop of haematite. The vein has a thickness of 7 ft. and is visible for a length of two miles along the mountain face. Thence the ore will be transported by an aerial ropeway to Innertkirchen below. Water power available from the Aar in the immediate neighborhood, amounting to 60,000 horse-power, will be used to drive the machinery required, and to supply the power for the electric smelting furnaces.—Lond. *Elec.*, Apr. 20.

REFERENCES.

India Rubber.—ARNAUD and VERNEWIL.—An article on a new process for the extraction of india rubber contained in the barks of different plants, especially the Landolphia plant.—*L'Elec.*, Mar. 17.

Paris Exposition.—FEUERLEIN.—An illustrated description of the electric central station of the Paris Exposition, especially of the German machines.—*Elek. Zeit.*, Apr. 12.

Educational.—An illustrated article on mechanical and electrical engineering at the University of Illinois.—*Elec. Rev.*, Apr. 25.

New Books.

WIRELESS TELEGRAPHY AND HERTZIAN WAVES. By S. R. Bottone. New York: Whittaker & Co. 116 pages, 35 illustrations. Price $1.00.

The preface of this little book says that the object in view has been to set forth, in simple language, the principles on which electric waves and wireless telegraphy are based. Of the four chapters the first two are devoted to a consideration of elementary electrical principles in the time-honored style, the familiar table of conductors being present, and painfully minute attention is given to the Leyden jar. The third chapter gives a description of the coherer and Marconi circuit, and the final chapter describes an amateur wireless telegraph set.

BOOKS RECEIVED.

HILFSBUCH FÜR DIE ELEKTROTECHNIK. Von C. Grawinkel und K. Strecker. Berlin: Julius Springer. 732 pages, 330 illustrations. Price, 12 marks.

THE COMPOUND ENGINE. A Series of Lectures. By F. R. Low. New York: The Power Publishing Company. 52 pages, 37 illustrations. Price, 50 cents.

THE TECHNIC OF MECHANICAL DRAFTING. A Practical Guide to Neat, Correct and Legible Drawing. By Charles W. Reinhardt. New York: The *Engineering News* Publishing Company. 36 pages, 62 illustrations. Price, $1.00.

TRAITE ELEMENTAIRE D'ELECTRICITE. Avec les Principales Applications. Par R. Colson. Third edition. Paris: Gauthier-Villars, 272 pages, 91 illustrations. Price, 3.75 francs.

Directory of Electrical Societies, Etc.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

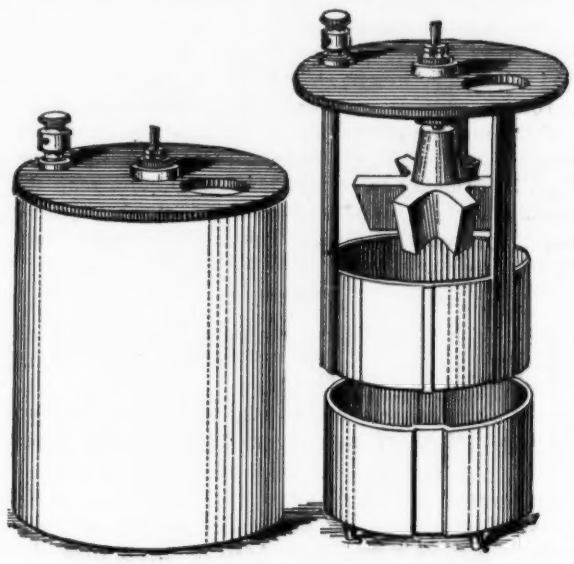
NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

A New Closed-Circuit Battery.

A closed-circuit cell of new pattern, and one particularly adapted for railroad signals, fire-alarm service and gas-engine or automobile work, is being placed on the market by the Federal Battery Company, New York. The cell is of the copper-zinc type with caustic potash as the excitant, but differs entirely in its construction from other cells of this type. The frame of the cell proper is made of cast-iron, and is in two sections. The upper part consists of the cover, suspending rods, and collar of the frame, with an adjusting cup of cast-iron which fits up under the collar and is suspended there on offsets or lugs by giving a half-turn of the cover section, having a bayonet-lock. This simple arrangement obviates handling the elements coated with caustic and saves the workmen from being burned when renewals are made. This feature of the cell will be appreciated by battery men who have the care of large numbers of batteries on railroads, etc.

In the iron cup of this cell is placed loose copper oxide, and suspended from the cover is a star-shaped zinc which is raised or lowered as desired, the positive connection being made to the cover by means of a set screw. The cell has an electromotive force of about 1 volt and has a capacity of over 450 ampere hours.

To renew the elements, all that is necessary is to lift the entire frame out of the jar, taking hold of the cover to do so, and setting it on the ground; by a half-turn of the upper section the cup drops out, and by turning it over the reduced copper can easily be removed with a stick and the cup refilled with a fresh charge of copper oxide. The zinc lasts for two charges of copper, and a fresh one



NEW PATTERN CLOSED-CIRCUIT BATTERY.

can readily be adjusted without once touching the caustic solution with the hands.

One of the valuable features of this cell is the impossibility of running out the battery rapidly if accidentally short-circuited, as in other closed-circuit cells. This point is of great importance in fire-alarm or railroad signal work, where a direct short circuit caused by accidental crossing of wires or otherwise might cause loss of life or great damage to property. Some of these cells have done telegraph relay work on the Pennsylvania Railroad for months, and have outlasted four or five gravity cells doing the same work.

Dry Cell for Testing Purposes.

A portable dry-cell test battery, known as the "Clover Leaf Test Cell," is being marketed by the Electric Contract Company, 61 Elm Street, New York. The voltage is 1.25, and as the cells are subject to very slight deterioration when not in use, they are ideal for testing purposes. The cell is mechanically well designed, the elements being contained in drawn pure zinc shells not subject to leakage, and can thus be grouped with the most delicate instrument without danger of spoiling the mechanism.

A good idea of the portability of these cells can be obtained from the statement that the dimensions of a case containing 99 cells

is 9 x 4¼ - 4¼ ins. and weighs only 15 lbs., and gives about 125 volts. The cases are highly finished and all parts are designed both for beauty in appearance and durability in actual service. By loosening four screws an exhausted cell can be quickly replaced in place of an exhausted one. After a battery is exhausted, it may be renewed at a nominal rate.

Opticians' Electromagnet.

An interesting application of the electromagnet in the medical art is in its employment for extracting metallic particles from the eye. A special form of electromagnet for this purpose is shown in the accompanying illustration, made by E. B. Meyrowitz, 104 East Twenty-third Street, New York. As will be seen the electromagnet is supplied with mechanical devices whereby it can be easily moved in any direction, so as to be placed over the eye of a patient while he is reclining in bed or sitting in a chair. The magnet rotates on a stand, can be raised and lowered by tilting the supporting bar, and can again be rotated in any direction in the gimble joint with which it is provided, as shown in the illustration. Each of these movements is provided with a safety clutch, so that when once placed in position, the magnet can be firmly held there. The magnet is provided with resistance box with a number of steps which gradually admit the current, and in this manner increase the drawing power of the magnet. The stand and supporting parts are enameled white, and the total weight of this magnet on its stand is about 600 lbs.

ELECTROMAGNET FOR OPTICIANS.

Experiments on the tractive power of the magnet have shown that with a piece of wood 1-5 in. thick interposed, a weight of 11½ ozs. will be supported; with 2-5 in. of wood, a weight of 6 ozs. and a weight of 3½ ozs. through 3-5 in. of wood.

Electric Ignition for Gas Engines.

The growing use of gas engines naturally brings into increased prominence the question of ignition, which in the past has been so much discussed with respect to the relative value of electric and of hot tube ignition. More recently the former method has enjoyed the greater favor, owing principally to the intelligent attention which its two important adjuncts—the battery and spark coil—have received in connection with this particular application.

The special requisites of a primary battery for gas engine work are that it shall deliver a perfectly constant current on closed circuit, not be subject to local action, have a long life per charge, and be simple of construction and not require expert care. The Edison-Lalande battery is claimed by the makers, the Edison Manufacturing Company, of New York, to most fully comply with these conditions, at the same time being moderate in price, while renewals may be obtained from any electrical supply dealer.

The battery is made in three sizes having capacities of 100, 150 and 300 ampere hours respectively, and in two types—one for stationary and the other for portable and marine use, the latter having enameled steel jars and liquid-tight covers. The two types are illustrated in Figs. 1 and 2. As will be seen, this cell is simple in construction, consisting of two zinc plates and a copper oxide plate held in two grooved vertical pieces of copper bolted together at the bottom, all three plates being suspended from the cover. The electrolyte is a solution of caustic potash on which is floated a layer of oil to prevent creeping and evaporation. For gas-engine work it is customary to use four or five of the 300-ampere-hour cell, five or six of the next smaller size or six or seven of the 100-ampere-hour size. The larger size has the advantage of less cells and less frequent renewals, while the smaller are lighter in weight and occupy less space, thus being better adapted for portable use.

The manufacturers of this cell, after thorough experiments with various sizes and shapes, have produced a spark coil for gas-engine use which is claimed to be highly efficient and economical. The coil, shown in Fig. 3, is 3½ ins. between the spool heads, or 6 ins. over all, and contains nearly six pounds of heavy copper wire tightly wound on a core of small soft iron wires, the core projecting beyond the spool heads. After winding, the coil is immersed in boiling paraffine to perfect its insulation. Owing to its design this coil magnetizes instantaneously, and when the circuit is broken demagnetizes instantaneously, thus producing a bright, hot spark for firing the igniter charge.

A New Method for Filling Lubricators.

The lubricator filler illustrated herewith was designed with a view to saving both oil and time. The lubricator sets on the steam chest, keeps the oil warm, and is filled once a week, there being required but a fraction of a minute to fill a pint lubricator. It relieves the engineer of the very disagreeable task of filling the lubricator by hand, reduces the oil bill by absolutely stopping waste, and is conducive to cleanliness.

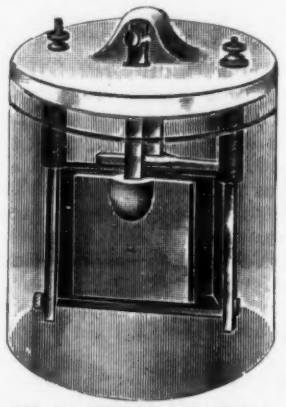


FIG. 1.—EDISON-LALANDE BATTERY.

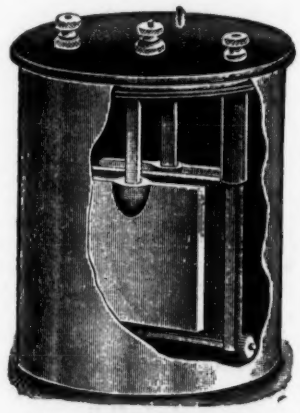


FIG. 2.—EDISON-LALANDE BATTERY.

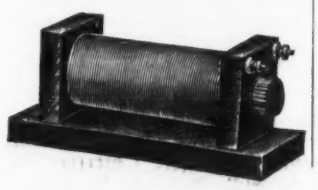
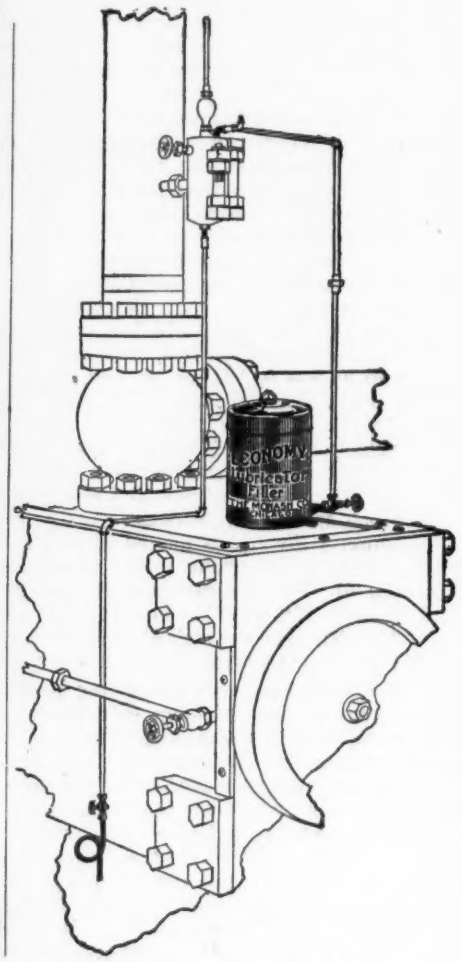


FIG. 3.—SPARK COIL.



LUBRICATOR FILLER.

Its operation is very simple. After closing off the steam and feed supply of the lubricator, the syphon valve, as shown near the base of the engine, is opened and also the angle valve at the reservoir of the filler. The water in the lubricator is then syphoned out, and as this is done the oil is drawn out of the reservoir of the filler into the lubricator. The manufacturers are the Monarch Company, 203 South Canal Street, Chicago.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The weekly statement of averages of the associated banks showed a large increase in cash and a much larger expansion of loans, the cash increase being over $3,000,000, and the increase in loans nearly $13,250,000. The surplus reserves show a net decrease of $1,095,800. During the week $2,600,000 were taken for export to Europe, but this had no effect on the tone of the loan market. Owing to the dull and heavy condition of the stock market the inquiry for money was somewhat smaller, and call loans were quoted at 1½@2¾. Time money is more freely offered, with only a moderate inquiry, the rates on prime collateral being 3@3½ per cent for short and 3½@4 per cent for long arrangements. There was an increased demand for commercial paper, while the supply also increased. The quotations for prime double names are 3½@4 per cent. In the stock market there was less interest and activity, and the volume of transactions was small. American Steel & Wire was irregular, as were also other leading industrials. Among the electric stocks General Electric reflected the inactivity of the general market. The sales for the week were 3588 shares, the closing price being 137, a net loss of three-quarters of a point. Western Union was also quiet, closing the week with a net loss of ½ point. The number of shares sold was 2930, the closing price being 82. Among the street railways, Brooklyn Rapid Transit was dealt in quite actively, the number of shares sold being 60,200. The net result of trading, however, was a loss of 1 point, the closing quotation being 73¾. This stock went down to 71 and up to 75¾ during the week. Metropolitan Street Railway closed the week with a net decline of 3¾ as compared with the previous week's transactions. The quotations fluctuated between 152 and 159, the closing price being 155¼. The sales aggregated 28,555 shares. Third Avenue shows a net gain of ⅞ point in the week's dealings. The sales were comparatively few, being but 3745 shares. The quotations maintained a steadiness which is absent in other street railway prices, ranging between 107 and 109, the closing price being 108. In the outside market there was a number of declines and in very few stocks was trading particularly active. Otis Elevator was one of the few stocks that showed substantial improvement. It reached 31, and closed the week with a net gain of 2 points. The electric stocks were all under more or less pressure. Electric Vehicle was for sale most of the week around 30, and some of the stocks of its subsidiary companies were lower than they had been at any time of late, and in fact some of them sold lower than ever in the past. New York Transportation declined to about 9, while Illinois Transportation sold as low as 1½, or 30 per cent of its paid-in value. General Carriage was another stock that had little support and sold off sharply. Electric Boat closed at 20, do. pfd. 45 asked; Electric Vehicle 27, do. pfd. 77; General Carriage 9¾; Telegraph, Telephone & Cable of America 5½. In the inactive list American Cable is quoted at 92; Commercial Cable 160, and American District Telegraph 27. Boston advices report a narrow and dull market. Massachusetts Electric is quoted at 25; West End 93¾; Bell Telephone 316; Erie Telephone 101¾; General Elec. pfd. 138; Westinghouse pfd. 61. The closing quotations on the Philadelphia exchange were: Electric Storage Battery 80; do. pfd. 90; Electric Company of America 9⅛; General Electric Automobile ⅞.

SNOQUALMIE FALLS POWER COMPANY.—Mason, Lewis & Co., bankers, of Chicago and New York, are offering $300,000 in 5 per cent first mortgage gold bonds of the Snoqualmie Falls Power Company. The total annual income of the plant under existing contracts to date is stated to be $123,120; the expenses $30,000, and $30,000 interest on $600,000 of bonds, leaving a net surplus of $63,120. This plant, which has been described in our columns, is located about thirty miles equidistant from Seattle, Tacoma, and Everett, Wash., to which cities electric power is transmitted directly, the line running over the company's own right of way. All the street railways and electric lighting plants in the cities of Seattle and Tacoma will, it is claimed, be run by this power. The officers of the company are Wm. T. Baker, Chicago, ex-president Chicago Board of Trade and World's Fair; A. H. Anderson, Seattle, vice-president Peninsular Railway Company; Sol. G. Simpson, Seattle, president Simpson Logging Company; Chas. H. Baker, Seattle, president and manager Snoqualmie Falls Power Company; James C. Drake, Tacoma, manager Snoqualmie Falls Power Company; Geo. G. Lyon, Seattle, secretary and treasurer Snoqualmie Falls Power Company.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY.—On April 28 a syndicate purchased the name, patents, good will and all tangible assets of the Western Telephone Construction Company from the receiver in the bankruptcy proceedings instituted earlier in the month. The assets were divided into three classes, one of which comprised the patents, and when this item was offered, the bidding was spirited, but the bid of the syndicate for the entire assets was for a larger amount than the three separate offers combined, so the new concern got everything. This syndicate is now incorporating a new company under the same name with a capital of $250,000, and the business is to be conducted at 153 to 159 South Jefferson Street, Chicago. The subscribers to the stock of this new company are said to be men of means, none of whom were connected with the old concern, and the business will not be hampered for the want of funds. It is also stated that the practical management of the business will be in the hands of men who stand at the head of the telephone business, and an effort will be made to operate the business on a very much larger scale than heretofore.

CONNECTICUT LIGHTING & POWER COMPANY.—A telegram to the *New York Times* reports that the syndicate known as the Connecticut Lighting & Power Company, which already controls a majority of the trolley lines and gas and electric light concerns in the State, and recently purchased water rights and power upon the Housatonic River, has now secured control of the water rights of the entire Saugatuck and Aspetuck Rivers, the Southport stream, the Westport Water Company & Electric Light Company, and formed a new organization under the name of the Southport Water Company. The telegram states that the syndicate intends to control the entire State in the electric and gas lighting, water power and trolley systems. In Norwalk over $500,000 is being expended in the erection of a modern gas, electric light and power plant.

AMERICAN BELL TELEPHONE STOCK.—In pursuance of the vote passed at the annual meeting of the Bell Telephone Company, a distribution of American Telephone & Telegraph stock will begin on May 15 on the basis of two shares of American Telephone stock for one of Bell Telephone. The directors of the American Telephone & Telegraph Company have voted to offer to stockholders new stock of that company for cash at par ($100 a share) in the proportion of one new share for every five shares of old stock. Each stockholder of the Bell Company on depositing his certificates for examination and exchange becomes entitled to subscribe for such new stock in the above proportion. The company will neither buy nor sell rights.

THE MARYLAND ELECTRIC VEHICLE & TRANSPORTATION COMPANY is being organized for the purpose of operating electric automobiles in Baltimore. The capitalization will be $500,000, of which $250,000 will be issued at once. It is understood that more than one-half of the stock has already been subscribed. The intention of the company is to supply both passenger and freight automobiles, and it will operate about 80 vehicles of various types. The organization will be a sub-company of the Electric Vehicle Company of New York. The meeting of the Maryland Company will be held as soon as the stock is subscribed, for the purpose of electing directors and officers.

SPRAGUE MORTGAGE.—The Sprague Electric Company last week filed a mortgage for $1,200,000 with the County Register in Newark, N. J., in favor of the Farmers' Loan & Trust Company of New York. The mortgage is given to secure an issue of bonds to the amount named above, and guaranteed by the trust company. It covers the plant of the Sprague Company at Watsessing, and the buildings at 527 to 531 West Thirty-fourth Street and 532 to 534 West Thirty-fifth Street, New York. The personal property covered by the mortgage includes 12,500 shares in the Otis Elevator stock.

THE WASHINGTON (D. C.) TRACTION & ELECTRIC SYNDICATE proposes to raise $3,000,000 for the completion of extensive improvements to its property. Several plans for raising the money have been under consideration. One of these contemplates the surrender by stockholders of $6,000,000 of the common stock of the syndicate. This stock will then be re-issued as preferred stock and deposited with a trust company as collateral for a loan of $3,000,000. No additional issue of bonds is contemplated and no further issue of stock.

THE ELECTRICAL VEHICLE TRANSPORTATION COMPANY.—The following is a summary of the report of the New York Vehicle Transportation Company for the fiscal year ended Dec. 31, 1899: Gross earnings, $156,568; operating expenses, $145,189; net earnings, $11,379; other income, $28,290; total net income, $39,670; patents, etc., $4,768; balance, $34,901.

THE ELECTRIC STORAGE BATTERY COMPANY.—According to a Philadelphia despatch, the actual gross sales of the Electric Storage Battery Company for the first quarter of this year aggregate in value $1,250,000.

THE UNITED STATES ELECTRIC SECURITIES COMPANY has declared a dividend of $5.25 on preferred stock, payable May 15. This is the dividend of 3½ per cent due Aug. 1, 1897, and the dividend of 1¾ per cent due Feb. 1, 1898, which until now have remained unpaid.

Commercial Intelligence.

THE WEEK IN TRADE.—The basic conditions of general business, such as the crop outlook, the export demand and the increased purchasing power of the people at large, Bradstreet's reports, show some improvement. Wholesale business is relatively quieter, but more than ordinarily marked attention is being concentrated upon the retail demand. The iron and steel situation is still an uncertain one. Manufacturers are reported looking for orders and prices are weakening, without, however, inducing much new business. One of the principal events in the iron market during the past week was the awarding to the Phœnix Bridge Company the contract for a great bridge over the St. Lawrence River at Quebec. This structure will require 27,000 tons of steel, and will be one of the largest of its kind ever built. Proposals are now being invited for the steel work on the approaches of the new East River Bridge in New York. This work will require 18,000 tons of steel. There is a heavy export in pig iron, and it is stated that about 100,000 tons may shortly be covered for foreign shipment. Sales of finished product have been made to a considerable extent for export, and prices are approaching a figure which is offering opportunities for the renewal of export business on a considerable scale. The domestic market continues favorable and prices are yielding under the strain of the recent developments, and a lower range of values is likely. The copper market was quiet and unchanged. The business during the week was on a rather small scale. The exports of domestic copper during April, according to figures compiled at the New York Metal Exchange, were 11,875 long tons. The quotations are: Lake, 17 cents; electrolytic, 16⅞@17 cents, and casting, 16¾@17 cents. In the machinery market, one of the largest purchases during the week was that of the Columbia & Electric Vehicle Company, of Hartford, Conn., which bought over $20,000 worth of machine tools. Reports to the commercial agencies show that the general business conditions are satisfactory. The business failures were the lightest in April that there is any record of since September last, the number being 13 per cent smaller than in March and 20 per cent smaller than in April a year ago, says Bradstreet's. For the week failures number 153, as compared with 182 the week before; 164 in this week a year ago, 240 in 1898, 228 in 1897 and 267 in 1896. The strike situation has been aggravated, a general labor movement having taken place on May 1. These strikes include electrical wiremen in many cities in the eastern section of the country. It is estimated that the number of men on strike during the week was 150,000. In many cases it appears that the demands of the workmen have been granted, notably the strike of freight handlers at Buffalo on the various railroads centering at that point.

USES OF ELECTRIC POWER IN HAMILTON, ONT.—Works for the electrolytic refinement of nickel and copper ores are to be established here. Commencing on September 1 next ten tons of matte, carrying not less than 40 per cent. of nickel and copper, will be supplied to the refinery daily, and on the first of each succeeding month the daily supply will be increased by ten tons until at the beginning of the sixth month it will reach sixty tons per day. The process to be adopted is the invention of Dr. Hoepfner, of Germany, and is claimed to be well adapted for treating the Sudbury ores. It is in use at Papenburg, Prussia, where the inventor claims it is producing one and a half tons of fine nickel per day. For these refining works, both of which will employ the electrolytic method, the City of Hamilton is well situated, owing to the large supply of electricity it commands. The same capitalists who have developed electric energy from the water power of the Welland Canal are also interested in the refining works. The outlook at present is for a very substantial enlargement of the works for producing electricity, for which purpose the waters of the Welland River will be tapped and brought down over the Niagara escarpment. A blast furnace with a daily output capacity of 800 to 1000 tons of pig iron is also projected. The company will have a capital of $10,000,000.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material, etc., from the port of New York for the week ended May 5: Antwerp—13 cases electrical material, $1,793. Alexandria—2 cases electrical material, $340. Argentine—64 cases electric motors, $4,388. Bremen—1 case electric motors, $18. British Australia—13 cases electrical machinery, $1,792. Bristol—2 cases electrical machinery, $125. Brussels—3 cases electric motors, $62. British West Indies—62 cases electric motors, $937. Christiania—1 case electric machinery, $93; 1 case electric motors, $32. Cuba—20 cases electric motors, $910. Central America—2 cases electrical machinery, $82; 76 cases electric motors, $199. Danish West Indies—2 cases electric motors, $26. Glasgow—11 cases electric machinery, $1,490. Genoa—11 cases electric motors, $6,971. Havre—19 cases electrical machinery, $1,262; 378 cases electric motors, $10,946. Hamburg—86 cases electric motors, $10,978. Hayti—1 case electric motors, $20. Japan—70 cases electric motors, $9,993. London—169 cases electric motors, $6,533. Liverpool—198 cases electric motors, $20,236. Mexico—178 cases electric motors, $8,934. Naples—61 cases electric motors, $4,000. Peru—31 cases electric motors, $6,649. Riga—3 cases electric motors, $716. Southampton—7 cases electric motors, $2,894; 48 cases electrical machinery, $765. St. Petersburg—1 case electric motors, $198. Stettin—60 cases electric motors, $1,829. Venezuela—23 cases electric motors, $478. Zürich—5 cases electric motors, $315.

MACHINE TOOLS FOR THE GOVERNMENT.—The Government has recently awarded contracts for machine tools for the Pensacola Navy Yard. They include punching and shearing machines, plate-bending rolls, open-side planer, straightening rolls, universal shears, drilling and boring machines, radial drills, all electrically-driven. The contractors are the U. Baird Machinery Company, Pittsburg, Pa.; Niles Tool Works, Hamilton, Ohio; Manning, Maxwell & Moore, New York, and Detrick & Harvey Machine Company, Baltimore. Twenty-eight other contracts were awarded at the same time for other machine tools, some of which will be supplied by the Prentiss Tool & Supply Company, New York, and the Garvin Machine Company, New York.

ELECTRICALLY-DRIVEN MACHINE TOOLS IN EUROPE.—Machine tools driven by electric motors are becoming extensively used in European factories, and they seem to be particularly favored in railway shops. In Carlsruhe, Germany, shops have recently been equipped with electric motors to take the place of steam engines, on the score of economy. In the wheel shops each lathe is driven by an individual motor. Altogether 12,000 ehp are used, effecting an annual saving in coal and maintenance of about $6,000. In France, electrical transmission is being largely employed by various railway companies.

THE C & C ELECTRIC COMPANY is building eight of its smaller generating sets for the sea-going tugs of one of the local companies. The dynamos are from 2½ to 5 kilowatts capacity, and will supply not only the ordinary lighting circuit but also current for the running lights and searchlights. During the last month European orders for over fifty C & C machines, aggregating over 500 horse-power, were filled. One of the large automobile companies recently organized has placed an order with the C & C Company for a number of 2-hp motors.

SIEMENS & HALSKE COMPANY IN MEXICO.—The report that Siemens & Halske, in the City of Mexico, has been absorbed by the General Electric Company, is denied by Mr. William Brockmann, manager of the Mexican branch of the former concern. Mr. Brockmann states that the Mexican branch has no connection with the Chicago house of the same name which was recently absorbed by the General Electric Company, but that it is a branch of the parent house in Berlin, which has branches all over the world.

BIG COPPER DEAL CLOSED.—A big deal in copper land, considering the price, has just been closed in West Superior, Wis. The Chippewa Copper Mining Company has taken up an option which it had on 71,280 acres, paying $50,000 for it. The people backing the Chippewa Company are Boston men. As soon as necessary machinery can be obtained the crew will be doubled. A new shaft is then to be started on the old vein 1000 ft. west of the original shaft.

ELECTRICAL PLANTS IN VLADIVOSTOCK.—The Russian Government will establish an electric railway and an electric light plant at Vladivostock, Siberia, the former to be 12 miles long. United States Commercial Agent Greener reports that no time limit has been set for sending in proposals, and that no favoritism on the ground of nationality will be shown. The city will be responsible for payment.

MEXICAN SUBMARINE CABLES.—The Secretary of Communications of Mexico, who is a Cabinet officer, has asked for bids for the laying of submarine cables to connect the several ports on the Gulf of Mexico. He is in communication with several large English firms on the subject of the probable cost of laying the cables.

WATER WHEELS FOR CHILI.—The American Impulse Wheel Company, of New York, will this week ship a number of 36-in. water wheels for an electric light plant, which is now being constructed in the vicinity of Valparaiso, west coast of South America.

BOILERS FOR JAPAN.—The Stirling Company, of Chicago, has just made a shipment to Japan of four 250-hp water-tube boilers, which are intended to be installed in one of the principal electric light plants in Japan.

Special Correspondence.

ENGLISH NOTES.

London Office of ELECTRICAL WORLD AND ENGINEER,
April 21, 1900.

MUNICIPAL TELEPHONES.—The effect of the municipalization of the telephone industry in this country is already being felt, and one of the first places to feel the grasping hand of the municipal authorities is London itself. The London County Council has laid down the law to the National Telephone Company, in that it is now refusing to grant any further permission for this company to lay its wires underground. On the other hand, the ground landlords are placing prohibitory prices upon the rights for overhead construction on the tops of their houses, so that the National Telephone Company has been already obliged in at least one district to notify its customers that it is reluctantly compelled to withdraw its services from that district. The National Telephone Company has already issued a circular to that effect explaining that the leaseholders who have hitherto permitted telephone wires to be fixed on the housetops have received injunctions from the estate authorities to terminate their contracts with the company unless paid prohibitory sums. The battle is, therefore, on between the present telephone interest in Great Britain and the municipal authorities.

THE AUTOMOBILE SHOW, which was held at the Agricultural Hall, Islington, in the north of London, has just been closed after a successful week. It is rather interesting to note, however, that only three exhibitors out of possibly 100 exhibited electric automobiles, those operated by petroleum seeming to be the most popular type. After the conclusion of the exhibition a banquet was given by the Automobile Club and on Monday morning of this week under the auspices of the same club the 1000 miles run was commenced from Hyde Park Corner at 7 o'clock in the morning. About 80 automobiles were entered, of which most were entered by manufacturers, a few only being entered by private owners. There is to be no speed exhibition on the road, a fair distance of from 50 to 100 miles being covered each day and rests being made at the various cities for the purpose of exhibiting the vehicles. The run is to be one for the purpose of showing endurance more than speed, and some sharp grades will be climbed on the road. Bristol was the terminus of the first day's run, a distance of 118¼ miles. Exhibitions are to be held at Cheltenham, Birmingham, Manchester, Kendal, Carlisle, Edinburgh, Newcastle, York, Leeds, Bradford, Sheffield, Lincoln and Nottingham, after which the survivors will exhibit their automobiles at the Crystal Palace for seven days. So far as heard from most of the vehicles have done well, and have arrived at Birmingham, where they have been exhibiting with great success.

DINNER OF THE BRITISH TRAMWAYS ASSOCIATION.—The inaugural dinner of the Tramways & Light Railway Association, which was held in the Victoria Hall, Hotel Cecil, on Wednesday evening of the past week, was a most successful affair. The list of members is already a large one, and the council contains many names of gentlemen well known in electrical enterprise in Great Britain. About 200 gentlemen sat down to dinner, the chair being taken by the president, Sir Charles Rivers Wilson. Mr. Balfour Browne, Q. C., proposed the toast, "The Houses of Parliament," and with a good deal of good-humored banter ridiculed the many phases of Parliamentary prohibitive legislation connected with the enterprise of installation of tramway systems. Mr. Atherley Jones replied to this toast in a happy manner and afterward Prof. Silvanus P. Thompson addressed the meeting with a vigorous speech, upholding in every particular the struggles which private enterprise is now having to make progress in Great Britain, and referring in most scathing terms to the bitter opposition which power schemes and tramway schemes are receiving at the hands of small corporations and local authorities, who do not seem to be able to understand what real progress means. Mr. John Young, manager of the Glasgow Tramways, and Mr. George Richardson, of the North Metropolitan Tramways Company, spoke regarding the success of their various companies. Mr. J. H. McGraw, of New York, in responding for the guests, said that it was pleasing to see that British manufacturers were rapidly coming to the front. He expressed the fear that in the next few years America would have to look for another market, besides Great Britain. He also stated that in 15 years he considered there would be no municipal tramways in Great Britain. Mr. Alfred Smithson, of the Leeds Tramways, proposed the health of the president, and Mr. Emil Garcke proposed a well-deserved vote of thanks to the secretary, Mr. Willcox. In the course of his remarks Mr. Garcke made a happy suggestion that if private enterprise and municipal enterprise could but become better acquainted they would each learn to have more respect for the other.

ELECTRIC LIGHTING IN DUBLIN.—The city of Dublin is at present divided as to what it should do as to its electric lighting supply. The Corporation of Dublin is discussing the building of a central station, at a cost of £100,000, for the purpose of supplying the city with electric light, a short distance from Dublin, at a district called the Pigeon House. Mr. Robert Hammond, consulting electrical engineer for the Corporation, has submitted a full report dealing with the situation, and recommends building a station on this site some three miles distant from the city and adopting the three-phase generating system, both for lighting and other purposes, which would be the first plant of the kind in the United Kingdom. He intends to install 6 Lancashire boilers, 4 water-tube boilers, 4 vertical compound or triple-expansion engines and 2 1000-kw generators and two of an output of 500 kilowatts. The three-phase current he proposes to transmit from the generating station to the centre of the city, where it would be transformed down for distribution to consumers, and the whole scheme has been designed to give a supply of current equivalent to 100,000 8-cp lamps. Many of the electrical engineers in this country have been called in to show that such a system is entirely practicable and economical. The curious feature of the case, however, is that the Dublin United Tramways Company, who has but recently completed its magnificent station at Wallsend, is also endeavoring to persuade the Corporation to purchase its supply of current for electric lighting from it, and it has made a proposition to the town clerk of the Corporation offering to furnish current at a lower cost per unit than it calculates that the Corporation can produce it for at the proposed new station at the Pigeon House. The tramways company offers to take the transfer of the lighting order and all the electric lighting property of the Corporation and offers to assume the existing liabilities of the Corporation and the repayment of the loan with interest. It offers to supply electricity for all purposes at a price calculated not to exceed 4d. per unit for the first million units, 4½d. per unit for the second million units and for all excess of the second million units 3d. per unit, and all public lighting to be supplied at 2½d. per unit. Or, if the Corporation will take the current, delivered as it were at the Ringsend station, it will furnish it at the following prices: 600,000 units at 2½d. per unit, 1,000,000 units at 2d. per unit, or 2,000,000 units at 1⅞d. per unit. It will be interesting to watch which of the two plans will be adopted.

General News.

THE TELEPHONE.

OXFORD, MISS.—W. H. Harvey has lately purchased the telephone exchange here.

AMBLER, PA.—The Ambler Telephone Company has commenced the erection of the new line through this place.

TIPPECANOE CITY, OHIO.—The Tippecanoe Telephone Company has been incorporated, with a capital stock of $10,000.

ALBANY, N. Y.—The Hudson River Telephone Company has declared a quarterly dividend of 1¼ per cent, payable on May 1.

CORSICANA, TEX.—Frank B. McElroy and associates were granted a 25 year franchise for an independent telephone system in this city.

AETNA, IND.—The Aetna Telephone Company has been incorporated by J. W. Scott, J. F. Beckman, L. Gerard, all of Aetna. Capital, $6000.

SMITHFIELD, VA.—The Smithfield Telephone Company has been chartered Capital, $25,000. Incorporators: P. D. Gwathmey, E. A. Morrison, both of Smithfield.

THE ERIE TELEPHONE SYSTEM made a net gain of 3169 subscribers in April. Total number connected April 30, 120,772; number waiting connection, 6625.

WOODBURY, N. J.—At a meeting of the County Board of Assessors it was agreed to assess the poles and wires of the different trolley lines and telephone companies.

THE PACIFIC COAST TELEPHONE SYSTEM made a net gain of 2012 subscribers in April; total number connected April 30 was 73,196, of which 18,688 are in San Francisco.

CENTRALIA, MO.—The Centralia Telephone Company was incorporated here with a capital of $6000, with J. A. Chance, president, and A. Bishop Chance, secretary and treasurer.

ARKANSAS CITY, KAN.—C. W. Penniman and C. E. Cory, of Fort Scott, and J. H. Montague, of Kansas City, contemplate establishing an independent telephone exchange here.

OSCEOLA, ARK.—The Osceola, Deckerville & Northern Railway Company will soon put Imperial bridging telephones on its lines along the road, between Deckerville and Osceola.

CAMDEN, N. J.—The Eastern Telephone & Telegraph Company has been incorporated here. Capital, $250,000. Incorporators: Joseph W. Morgan, John J. Burleigh, E. A. Armstrong.

LEWISTON, ME.—The Eastern Telephone Company has increased its capital from $100,000 to $500,000. It is said that the purpose of the increase is that the company may extend its business.

LUFKIN, TEX.—The Lufkin Telephone Exchange, of Lufkin, Tex., has been incorporated. Capital stock, $10,000. Incorporators: W. M. Glenn, L. M. Wettermark, A. M. Denman and others.

FALL RIVER, MASS.—The Southern Massachusetts Telephone Company has filed a petition to lay underground conduits in a number of streets to accommodate wires that are now strung on poles.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company has filed a mortgage for $10,000, covering the company's entire plant in the twin cities. The mortgage is given to Thorpe Bros.

DES MOINES, IA.—The Iowa Telephone Company expended $300,000 in improvements on its lines and exchanges last year, and expects to make a further outlay of $500,000 this year for the same purpose.

KANSAS CITY, MO.—The Kansas City Telephone Manufacturing Company, of Kansas City, has been incorporated. Capital stock, $5000. Incorporators: E. L. Foutch, F. M. Beradin and E. R. Rogers.

ST. MARYS, W. VA.—The McKin Telephone Company, of St. Marys, has been chartered. Capital, $50,000. Incorporators: R. H. Browse, O. Gorrell, B. F. Sockman, A. Eddy, W. C. Dotson, all of St. Marys; W. C. Dotson, attorney, St. Marys.

ORLANDO, FLA.—The telephone exchange is building an extension in a southeasterly direction, to Conway, and the turpentine camp of McQuaig & Beecham; also to Pinecastle, and to the turpentine camp on the Big Cypress, just south of Pinecastle.

HOLSTEIN, IOWA.—The Holstein Telephone Company, of Holstein, Ida County, has filed articles of incorporation with the Secretary of State. It has a capital stock of $2500. R. H. Smith is president; John Wents, vice-president, and W. F. Hutton, secretary.

ALBANY, N. Y.—The Marlaville & South Schenectady Telephone Company has been organized by the election of these officers: President, R. C. Cullings; secretary, C. A. Cullings; treasurer, D. N. Walpole; directors, Fred Frost, Sam'l Robinson, D. N. Peck and Delmont Gregg.

SAN ANTONIO, TEX.—The San Antonio Telephone Company, of San Antonio, has been incorporated. Capital stock, $400,000. Incorporators: H. M. Aubrey, F. C. Smith, of San Antonio; W. M. Daugherty and Charles H. Rosser, of Columbus, Ohio, and James H. Brailey, of Wauseon, Ohio.

ALBANY, N. Y.—The United States Automatic Telephone Company, of New York City, has filed a certificate with the Secretary of State, announcing that half of its capital stock, which amounts to one million dollars, has been paid in. Its directors include Elias E. Ries, Israel Steinhart and Simon Sterne.

HARTFORD, KY.—The Rough River Telephone Company, which was recently incorporated, contemplates extending its lines to Owensboro and Bowling Green. The company includes the Commercial Telephone & Telegraph Company and the Hartford Telephone & Exchange Company, all of which are operated together.

ALBANY, N. Y.—The Franklin County Telephone Company, to operate in Malone and other villages of Franklin County, has been incorporated. Capital, $8000. Directors: E. B. Ferensen, J. A. Crawford, M. S. Crawford, N. S. Ferensen, John Chambers, R. L. Crawford, of Hamden, and Frederick C. Ward, Delhi.

KAUKAUNA, WIS.—The Wisconsin Telephone Company, which recently had orders to stop work in South Kaukauna on account of the company's objections to some amendments which the council added to its franchise, has again begun work of setting taller poles and adding cable boxes in the business streets of the south side.

NEW ORLEANS, LA.—There is considerable talk here of organizing an independent teelphone company to take the place of the defunct People's Company and to continue the fight against the Cumberland Telephone & Telegraph Company. The present plan is to have the new company controlled by the city in a manner similar to that proposed in Chicago.

BOSTON, MASS.—The following is a list of officers and directors of the American Telephone & Telegraph Company: President, John E. Hudson; vice-president, Edward J. Hall; treasurer, William R. Driver; secretary, Melville Egleston; directors: Charles W. Amory, Melville Egleston, John E. Hudson, Alexander Cochrane, Edward J. Hall, Edward P. Meany, Joseph P. Davis, Henry S. Howe and William D. Sargent.

BOSTON, MASS.—The instrument statement of the Bell Telephone Company for the month ended April 20 shows the following results:

	1900.	1899.
Gross output	53,190	61,481
Returned	20,077	13,079
Net output	33,113	48,402

Since Dec. 20:

	1900.	1899.
Gross output	236,193	224,325
Returned	83,121	54,804
Net output	153,072	169,521
Total outstanding	1,733,577	1,294,767

KINSMAN, OHIO.—The Central District Printing Telegraph Company, of Pittsburg, is at work in this section, securing right of way for the extension of its telephone system to Cortland, Kinsman, Bristol, West Farmington and Mesopotamia. Village systems will be installed in the towns sanctioned, which will be given long-distance service. It is stated that the company will also extend a circuit from Warren to Braceville, Windham, Freedom and Ravenna.

ELECTRIC LIGHT AND POWER.

TOLEDO, OHIO.—The Toledo Bridge Company will put in an addition to its power plant.

RED BUD, ILL.—At the ctiy election on April 17 an appropriation of $10,000 for an electric light plant was carried.

HUNTINGDON, PA.—The Huntingdon Mills Electric Light & Power Company has been incorporated, with a capital of $1000.

FRANKLIN, N. H.—At the annual meeting of the Franklin Light & Power Company a 6 per cent dividend was declared for the year.

TRENTON, N. J.—The Consolidated Electric Company filed papers with the Secretary of State increasing its capital from $100,000 to $4,000,000.

BOWLING GREEN, KY.—Col. M. H. Crump, secretary of the Commercial Club, is in the market for an incandescent plant of 5000 lights, with engine and boiler equipment.

CELINA, OHIO, has advertised for bids for a $25,000-electric light plant. An election is soon to be held by the people to determine whether or not the proposition shall be encouraged.

FREMONT, OHIO.—The Creager Electric Light Company's plant here has been sold to eastern capitalists. This includes the street railway line, which was abandoned some time ago.

MEDFORD, ORE., recently acquired the electric lighting plant installed two years ago by private enterprise. The light and water systems will be operated under one superintendent.

DICKINSON, S. D.—Alexander Hughes, of Fargo, N. D., has purchased the Dickinson Electric Light Company's franchise of Dickinson, S. D. The plant will be completed within two months.

PHILLIPSBURG, N. J.—The Lehigh-Northampton Gas & Electric Company has been incorporated at Phillipsburg, N. J. Capital, $250,000. Incorporators: Liddon Flick, W. H. Walters, E. G. Holzer.

PERU, IND.—The City Lighting Company, of Peru, has been incorporated to furnish electric light and power. Capital, $25,000. Incorporators: S. V. Parrott, H. C. Ulen, A. G. Parrott, all of Peru.

SUNDERLAND, ONT.—The Sunderland Electric Power Company, of Sunderland, Ont., has been incorporated to supply light and power. Messrs. James McDermott and Henry Baldwin are directors.

MILWAUKEE, WIS.—The Northwestern Mutual Life Insurance Company has purchased a 30-kw Milwaukee Electric Company generator direct connected to an Ideal engine, for its building in this city.

DENVER, COLO.—A suit has been begun in Denver to prevent the city from entering into the contract with the Lacomb Electric Company under the franchise recently granted for municipal and electric lighting.

ATZCAPOTZALCO, MEXICO.—The town of Atzcapotzalco, situated near the City of Mexico, has signed a contract with Siemens & Halske, of the City of Mexico, for the installation of a municipal electric light plant.

VICTORIA, MEXICO.—The contract has been signed for the installation of an electric light plant in the city of Victoria, in the State of Tamaulipas, Mexico. The plant will supply the city and private customers with light.

NEWARK, OHIO.—A report recently made to the city council shows that the cost of operating the municipal lighting plant for the past year was $37.10 each for 250 arc lights. This includes interest on bonds amounting to $1750.

BOSTON, MASS.—The gas and electric light commissioners gave a hearing to the officers of the Worcester Electric Light Company on an application for an increase of capital of $100,000 for additional conduits and extensions.

REPUBLIC, WASH., will have electric lights, supplied by a company to be organized by F. C. Whitney, who has been granted a franchise for a light and water system. A plant costing at least $75,000 is to be completed by Nov. 15 next.

BRANTFORD, ONT.—The Brantford Electric Light Company, of Brantford, Ont., is having plans prepared for the construction of new lock, and has under consideration the installation of an additional 600-hp water wheel and an auxiliary steam plant.

THE SIDELL ELECTRIC LIGHT, COLD STORAGE & ICE COMPANY, of Sidell, Ill., has bought the pole line and good will of the old company, and will put in a complete new alternating equipment, employing Potter & Benson, of Chicago, as the engineers.

YORK, ME.—The Agamenticus Light & Power Company, of York, has been incorporated. Capital, $50,000. Incorporators: E. S. Marshall, J. P. Bragdon, J. P. Putnam, J. C. Stewart, all of York; F. D. Marshall, of Portland; F. D. Marshall, attorney, York.

ATLIXCO, MEXICO.—A town of a size sufficient to accommodate several thousand people, who are employees of the Atlixco cotton mills, near the City of Mexico, is to be built by the owners of the mills. The town is to be equipped with a complete electric light system.

HAMILTON, ONT.—Work has been commenced on the construction of the new power transmission line to run along the mountain from Cataract Power Company's station at the DeCew Falls to the city of Hamilton, Ont. The work will be finished and the line ready for operation on July 1 next.

DENVER, COLO.—The movement for underground wires in the city of Denver seems to have made quite a little progress since the recent storms have caused such a demoralization of the overhead circuits. The newspapers are urgently demanding the burial of the wires, especially in the business section of the city.

NORWALK, CONN.—The Connecticut Lighting & Power Company's offer to the city of South Norwalk of $90,000 for its electric lighting plant will be refused. The plant has cost the city of South Norwalk, approximately, $60,000. It is paying at the present moment at the rate of 4 per cent interest on $120,000.

SOUTH PARIS, ME.—At the annual meeting of the South Paris Light, Heat & Power Company Friday the following officers were elected for the ensuing year: President, N. Dayton Bolster; clerk and treasurer, George M. Atwood; directors, N. Dayton Bolster, Leander S. Billings, J. Hastings Bean, J. F. Plummer.

OTTAWA, ONT.—Incorporation has been granted to the Capital Power Company, of Ottawa, with a share capital of $300,000. The company will deal in water power and electric and other motive powers. The provisional directors of the company are W. J. Conroy, O. H. Conroy, John McBain, J. C. Browne and R. J. Devlin.

RED BLUFF, CAL.—The Red Bluff Electric Light & Power Company was recently incorporated, with Red Bluff, Cal., as the principal place of business. Directors: D. S. Cone, C. F. Foster, E. H. Ward, of Red Bluff; J. D. Sherwood, Spokane, Wash.; W. N. Woodson, New York. Capital stock, $250,000; subscribed, $185,000.

DOWNER'S GROVE, PA.—Downer's Grove is now illuminated by electricity. The electric lighting system was decided on last winter after the project was submitted to the people for approval. The system includes 22 arc lights of 2000 candle-power each, distributed along the principal streets, and 80 incandescent lights on the side streets.

ATHENA, ORE.—The Athena (Ore.) Company that was organized to transmit electric power from the upper Walla Walla River to Walla Walla, Wash., Athena and Weston, Ore., has decided to install a water-power electric plant costing $100,000. A considerable amount of electric power is needed for manufacturing in those localities.

SAN FRANCISCO, CAL.—The Standard Electric Company, of California, which has floated bonds in the East to the amount of $5,000,000, will probably have its pole line from Blue Lakes completed to Alviso by June 1, or earlier. At Alviso three lines will branch out to reach different portions of the territory surrounding San Francisco Bay.

ALBANY, N. Y.—Governor Roosevelt has vetoed the bill which permitted electric light companies to condemn land in cities. The bill was introduced at the request of the large electric light companies in New York City, which desired to condemn and purchase property adjacent to their plants, the owners of which had brought suits for damages caused by noise and vibration.

CANON CITY, COLO.—At a recent election the Colorado Electric Power Company, of Canon City, which operates the splendid plant which transmits

power for the mines in the Cripple Creek district, was granted a franchise for Canon City, and will install additional apparatus for that purpose. It will enter into competition with the company which now supplies current for that city.

COLUMBUS, OHIO.—The electric light fund of the city has become exhausted, and Director Kauffman has announced that the municipal lighting plant which furnishes current for 350 lights on the north side of the city will be abandoned. The companies furnishing contract lamps have been notified to redistribute their lamps in order to cover the territory in the best manner possible.

BALTIMORE, MD.—Proposals have been made for a combine between the Consolidated Gas Company and the United Railways & Electric Company. It is reported that the gas company has asked the United Railways & Electric Company to fix a price for the $2,000,000 common stock of the electric light company. This would give the gas company absolute control of the lighting of the city.

SAN FRANCISCO, CAL.—Claus Spreckels, who is furnishing the funds for the Independent Electric Light & Power Company's new system in San Francisco, has signified his willingness to build an electric distributing system for the municipality at cost. His engineers are now at work on the estimates for the same. It is claimed that by buying current under competition the city could save $140,000 yearly.

BEAVER DAM, WIS.—The Beaver Dam Electric Light Company is remodeling its plant, including installation of new dynamos, engines, boilers and line construction, and will be in the market for alternating-current fan motors, arc lamps, fixtures and supplies. Mr. F. S. Richmond is superintendent of the installation at Beaver Dam. This company will have for sale the old boilers, engines and dynamos.

SAN FRANCISCO, CAL.—The establishment of an electrical power plant on the McCloud River, in Shasta County, is a certainty. Electricity is to be generated at a point two miles above Baird and transmitted to the mines in the county and to Redding for light and power. The present capacity of the plant will be 6000 horse-power, with provisions for an increase when necessary. It is estimated that the cost of installing the plant will be $350,000.

ST. LOUIS, MO.—The old arc lighting contracts of 1890 held by the Missouri-Edison Co. south of Washington Avenue and the Laclede Gaslight Co. north of Washington Avenue, expired Monday night, April 30, and the temporary contracts secured by the same contractors in the same territory became effective Tuesday, May 1. The temporary contracts are the principal ones of those which cost St. Louisians $90,000 additional this year. They will expire Sept. 1.

GRAND FORKS, B. C.—The Cascade Power & Light Company, of Grand Forks, B. C., is developing 12,500 horse-power at the falls in the Kettle River at Cascade, 12 miles from Grand Forks. The dam is built near the head of the Cascade Gorge, and it is 400 ft. long and 40 ft. at the base. The flume will be 700 ft. long. The object of this enterprise is primarily to furnish power for mine development, and a secondary object is to supply lighting current to the boundary towns.

ILION, N. Y.—The board of trustees held a special meeting at which the subject of municipal ownership of the electric light plant was discussed. A committee composed of S. G. Heacock, R. D. Morgan, B. B. Van Deusen and L. N. Walker was appointed to let the contract and look after the installing of a new plant for both street and incandescent lighting. At the last charter election an appropriation of $30,000 was voted for this purpose and work will be commenced at once.

MONTREAL, QUE.—The Lachine Rapids Hydraulic & Land Company, of Montreal, Que, has, within the past two months, installed three new generators of 1000-hp each, and a fourth generator of the same capacity is now about to be installed, thus increasing the capacity of the works by 4000-hp. Some changes have recently been made in the method of driving the exciters of the power house. Instead of being driven from the main shaft, they have been put in brick buildings and driven by independent wheels.

BURLEIGH FALLS, ONT.—At a meeting of the shareholders of the Central Ontario Power Company, proprietors of the Burleigh Falls water power, lately incorporated, with a capital of $750,000, the following directors were elected: Hon. Richard Harcourt, Toronto, president; F. A. Hall, Perth, vice-president; J. Alex. Culverwell, managing director; Senator McLaren, Eugene Coste, M. E. James Kendry, R. J. McLaughlin, F. W. Barrett, Edw. T. Adams, H. J. Taylor and H. E. Larkin. The company has opened its head office at Peterboro, Ont.

CAMDEN, N. J.—Thirty men with axes recently cut down all the poles of the Merchantville Light, Heat & Power Company in Camden's annexed district, and nearly all the business houses were in total darkness. The men worked under the direction of the commissioner of streets, who acted on a resolution adopted by the City Council. Camden city claims that the Merchantville Company had never been granted a permit to erect the poles. The company claims the right under an ordinance granted by a former township committee.

ROCHESTER, N. Y.—The stockholders of the Rochester Gas & Electric Light Company have elected directors as follows: J. Lee Judson, Hon. Frederick Cook, William Dunkle, George W. Archer, A. H. Harris, G. C. Hollister, G. A. Hollister, H. L. Brewster, W. S. Johnston, H. G. Runkle, J. N. Beckley, G. E. Redman, W. J. Cole. Following are the officers of the board: President, J. Lee Judson; first vice-president, William Runkle; second vice-president, Hon. Frederick Cook; treasurer, G. W. Archer; secretary and assistant treasurer, W. L. Cole; attorney, A. H. Harris.

VANCOUVER, B. C.—The legislature of British Columbia has granted incorporation to the Stave Lake Power Company, with an authorized capital of $1,000,000. The company has acquired the right and title to 75,000 inches of water at Stave River Falls, a point 42 miles from the city of Vancouver. It is proposed to generate the power at the falls and transmit it to Vancouver. It is said that the company is at the present stage of the enterprise, assured of the sale of over 4000-hp on yearly contracts. The reports made by the engineers show that 17,000 hp can be generated at the falls, and that by additional hydraulic works this amount can be doubled. The cost of the project is estimated to be $515,000.

THE ELECTRIC RAILWAY.

FOND DU LAC, WIS.—The Street Railway Company will make some extensions in its tracks, to cost about $12,000.

CANTON, OHIO.—The Canton-Massillon Electric Railway Company has increased its capital stock from $600,000 to $1,000,000.

ELMIRA, N. Y.—David N. Heller has applied to the Railroad Commission for an electric road 18 miles long from Elmira to Corning through Horsehead.

TRAVERSE CITY, MICH.—The City Council has granted a franchise to the Traverse City, Old Mission & Peninsula Railway to run street cars through this city.

COLUMBIA, PA.—Work on the Montour-Columbia Electric Railroad will begin soon. The surveys have been made and bids for its construction are being invited.

MENOMINEE, MICH.—The project of establishing an electric railway line through Menominee County to connect this city with Escanaba is again being agitated.

WILMINGTON, DEL.—It is said that the right of way between Wilmington and West Chester, Pa., has been secured and work on the proposed trolley line will soon begin.

PALMER, MASS.—The Palmer & Monson Electric Railroad Company has petitioned the selectmen of Ware for a franchise to extend its lines into the village of Ware.

ST. JOHNS, MICH.—The promoters of the electric railroad from Lansing to this city are trying to have the towns along the route of the road subscribe a total of $100,000.

PITTSBURG, PA.—The financial report of the Union Traction Company for March shows: Gross earnings, $148,009; net, $82,814; interest, rentals, taxes, etc., $59,099; surplus, $23,714.

PITTSBURG, PA.—The Monongahela Traction Company has begun to operate its new line through Braddock and Duquesne, connecting with the East Pittsburg and Wilkinsburg branches.

PHILADELPHIA, PA.—The Union Traction Company is installing heavier machinery in the power house at Willow Grove, and it is said the Doylestown line may be operated from that point.

PITTSBURG, PA.—Employees of the United Traction Company and of the West End Traction Company, numbering in all about 1050 men, have received an advance in their wages of 40 cents per day.

BOSTON, MASS.—The proposed sale of the Winchester Avenue Street Railway stock by the New England Street Railway to I. A. Kelsey was defeated at the stockholders' meeting of the latter road.

BINGHAMTON, N. Y.—New York capital has been interested and an electric railway is to be built from Union to Main, connecting the latter village with this city. The road will be 18 miles in length.

CLEVELAND, OHIO.—The strike of the Big Consolidated Street Railway employees, inaugurated nearly a year ago, was declared off on May 3. Secret negotiations had been in progress for some time.

CHICAGO, ILL.—The West Chicago Street Railway Company will pay the regular quarterly dividend of 1½ per cent on May 15. The dividend is guaranteed by the Chicago Union Traction Company.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has made application to the State canal commission for the lease of the berme bank of the canal between Newark and Hebron.

URBANA, ILL.—The Urbana Merchandise Electric Railway Company, Urbana, has been incorporated. Capital, $100,000. Incorporators: H. A. Axline, C. McDonald, G. W. Hitt, J. B. Johnson, E. M. S. Huston.

PITTSBURG, PA.—The United Traction Company, of this city, has inaugurated a system of transfers in the city of Allegheny, and beginning with May 1 passengers will be ble to ride all over the city for one fare.

BALTIMORE, MD.—Alexander Brown & Sons have entered into an agreement with the United Railways & Electric Company to purchase from the latter $3,000,000 of its first consolidated mortgage 4 per cent. bonds.

ST. LOUIS, MO.—Rumors of negotiations between the St. Louis Transit Company and the St. Louis & Suburban Railroad Company, involving the purchase of the latter system by the former company, have been current for a week past.

ALBANY, N. Y.—The United Traction Company is now in its new offices at Broadway and Columbia Street. H. A. Benedict, electrical engineer of the Hudson Street Railway, has accepted a similar position with the United Traction Company.

BEAVER, PA.—A party of New York capitalists are negotiating for the purchase of the Beaver Valley Traction Company's lines, the line of the Riverview Electric Street Railway Company and the plant of the Patterson's Heights Incline Plane Company.

CHICAGO, ILL.—A bid of $325 a share is reported to have been made for control of the Chicago City Railway by the Chicago Union Traction Company. The largest holders of the Chicago City Railway shares say that they have no knowledge of such a bid.

CHICAGO, ILL.—Thieves recently cut down 4500 ft. of feed wire from the poles of the Calumet Electric Street Railway Company in Pullman Park, and made their escape. It was not until an effort was made to start the cars that the loss was discovered.

MANCHESTER, MO.—The St. Louis Transit Company was incorporated Nov. 18, 1899, with a capital stock of $140,000, to build a 14-mile line between Manchester and St. Louis. Orders have not yet been placed. The company may be addressed at 700 Carlton Building, St. Louis, Mo.

BELLEVILLE, ILL.—The trouble on the electric railway between Belleville and East St. Louis has been adjusted. The trackmen have been granted the in-

crease they asked. It appears that they continued to work while the negotiations were pending and did not carry their intention of striking into full effect.

SEATTLE, WASH.—Rights of way for a double-track, standard-gauge electric railway between Tacoma and Seattle, Wash., have been secured by W. P. Trimble and Fred E. Sander, of Seattle. They claim to have funds for the construction of the road as soon as the surveys are completed.

KENOSHA, WIS.—Messrs. Haynes and Clausen, of Chicago, were in conference with a special committee appointed by the common council in this city in regard to a franchise recently introduced in the council asking for a thorough electric line which would form the connecting link between Milwaukee and Chicago.

OSHKOSH, WIS.—The Oshkosh real estate board has succeeded in securing a franchise for an electric road from this city to Berlin, taking in Omro, Wausau and Eureaka and also Butte des Morte and Winneconne on another line. It is proposed to interest Eastern capitalists in the building of the road. The road will be 21 miles long.

TOLEDO, OHIO.—C. L. Cresswell of this city has secured contracts for the steel structural work for three power houses which the Toledo, Fremont & Sandusky Electric Railway Company is preparing to build. One station will be located near Toledo; another at Genoa, and the third at Hassville. The company will erect the buildings itself.

PITTSBURG, PA.—Mr. W. K. Schoepf, the new general manager of the Consolidated Traction Company has issued orders to the effect that in the future the company will not place any advertising matter on the car windows. This has been a practice in this city for years, by which sometimes all the windows would be obscured with bill posters.

NEW YORK, N. Y.—Justice Garretson, of the Supreme Court, has handed down a decision declaring that the franchise given to the New York & North Shore Railroad Company by the Board of Trustees of the late village of Jamaica is illegal. The decision perpetually restrains the company from constructing a railway on Highland Avenue.

MILWAUKEE, WIS.—The Falk Company has lately signed contracts with several of the large street railways in this country for construction work on their lines. This work includes welding the rail joints and overhauling the lines in general. The company is very busy and as its new factory buildings are not all complete it is somewhat handicapped.

BOSTON, MASS.—The committee on street railways in the Massachusetts House of Representatives has reported a bill to permit street railways to carry freight, packages and merchandise. If passed, the bill will make electric railways competitors of steam railways to a great extent. The electric roads have already cut into the steam lines largely in the neighborhood of Boston.

MONTGOMERY, ALA.—The State Supreme court here has decided a case where a street railroad company enforced a rule that whites and negroes should occupy separate portions of the car set apart for them respectively. A negro woman was put off the car for refusing to obey the order and sued for damage. The lower court decided in favor of the railroad and the Supreme court affirmed the decision.

ST. LOUIS, MO.—Within the next ten days, the work of changing the Broadway cable system to electricity will begin. The change will require nearly four months, during which time the line will practically be out of service. When all the improvements are made new rolling stock will be placed on the system and the Broadway electric line will then be one of the best systems of electric railway in the country.

LITTLE ROCK, ARK.—President Allen N. Johnson, of the Little Rock Traction & Electric Company has asked the United States District Court to appoint a receiver for the company on the ground that the company is unable to operate its cars because of the strike. Judge Williams appointed Mr. Johnson receiver of the company's property. He also issued an order restraining any one from interfering with the operation of the cars.

EASTON, PA.—The Delaware River Quarry & Construction Company has petitioned for the appointment of a receiver for the Bethlehem & Nazareth Electric Railway Company. The construction company recently entered suit against the trolley company for $32,000 the amount alleged to be due it for the construction of the line. The Bethlehem & Nazareth Company's line was recently leased by the Lehigh Valley Traction Company.

PITTSBURG, PA.—A number of capitalists from Duquesne, Pa., among whom are Messrs. Charles D. Wiser, Boyd M. Davies, W. S. Bryan, T. V. Bay and T. C. Ingham, have organized a company to construct an electric railway from Harrisburg to Sunbury, in this State, a distance of 78 miles. Mr. Wiser is president of the company. The capital stock of the company at present is $50,000. Work will begin at once.

NEW HAVEN, CONN.—On Monday, May 7, was inaugurated an express service by trolley, reaching from Shelton, Derby and Ansonia to Bridgeport, Fairfield, Westport, Norwalk, Darien, Milford, West Haven, and this city. There is a double service daily, with rates of about 30 cents 100 lbs. between Shelton and Bridgeport and this city, smaller packages ranging from 15 cents upward. Special box cars 35 ft. long have been built for the service.

PITTSBURG, PA.—The West End Traction Company of this city has set aside $300,000 to be expended upon improvements and extensions of its lines. The company has bought 20 new cars from the St. Louis Car Company. It is now erecting a new boiler house, and it will extend its lines for five miles from Carnegie to Bridgeville. This extension will open up an entirely new territory, from which the people will be able to obtain rapid transit to the city of Pittsburg.

CHESTERTOWN, MD.—A number of prominent citizens of Kent are considering the practicability of an electric railway from the bay shore, either at Rock Hall or Tolchester, to Middletown, Del. The route considered will touch Chestertown, Kennedyville, Locust Grove and Galena, a distance of 41 miles, and it is estimated would cost about $500,000. A large power plant in the event of the establishment of the road would be placed at Rock Hall or Tolchester, Chestertown and Middletown.

PITTSBURG, PA.—The board of directors of the Pittsburg Traction Company has declared a dividend of 3½ per cent, payable to stockholders of record on April 24. Checks were mailed May 2, 1900. The board of directors of the Duquesne Traction Company has declared a dividend of 2 per cent to stockholders of record on April 24. Checks were mailed May 2. The board of directors of the Central Traction Company has declared a dividend of 1½ per cent, payable to stockholders of record on April 24. Checks were mailed May 2.

NEW YORK, N. Y.—The report of Receiver Grant, of the Third Avenue Railroad Company, for the period from Feb. 28 to March 31, inclusive, shows receipts of $214,885.25, with disbursements of $132,330.54. The balance sheet shows debits of $189,618.44, including $5,962.56 repaid by the Forty-second Street Manhattanville & St. Nicholas Avenue Railroad Company. The schedule of credits include $22,916.67 for accrued interests on the funded debt and $11,330.39 for accrued taxes. The report shows net earnings for the month of $68,000 and a net surplus of $33,800.

COLUMBUS, OHIO.—The National Traction Company, which is backed by Charles W. Mackey, of New York, is at work securing franchises for an electric road through Franklin, Madison, Clark, Miami and Darke counties, and thus far the company has been successful in Miami County. The project is for an electric road following the National road from Columbus to the West State line connecting at that point with a road to Indianapolis. It is also proposed to run a number of branch lines from the main line, to connect with small towns. N. H. Albaugh, of Troy, Ohio, is at the head of the new company.

ST. LOUIS, MO.—The St. Louis county court, April 14, acting on the application of the citizens of Wellston, issued an order restraining the St. Louis County Street Railroad, the United Railways and the Wellston, Creve Coeur Lake & St. Charles Railway from laying tracks or erecting poles on the St. Louis Rock road. The companies have failed to come to any agreement, despite the order of the county court demanding them to settle the matter amicably among themselves and use only two tracks on the road. Three tracks are now on the streets of Wellston, one of the four tracks having been taken up by one of the companies.

ST. LOUIS, MO.—The city register has received from the street railway companies of St. Louis the regular quarterly returns showing the number of trips made and the passengers carried during the three months ending March 31. The figures are as follows: St. Louis & Suburban Railway Company and St. Louis & Meramec River Railway Company, 54,266 trips and 2,905,941 passengers; St. Louis Traction Company (People's Railway Company), 22,533 trips and 752,969 passengers; St. Louis Transit Company, including Baden, St. Louis and Southwestern lines, 74,386 trips and 3,191,725 passengers; St. Louis Transit Company, 1,170,906 trips and 23,093,891 passengers; total, 1,322,091 trips and 29,944,526 passengers. This is a decrease compared with the returns for the quarter ending Dec. 31, 1899, which showed 1,558,315 trips and 32,783,639 passengers.

THE AUTOMOBILE.

ELKHART LAKE, WIS.—An automobile line will be established to run between Elkhart Lake, Lakeside Park and Glenbeulah.

THE ST. LOUIS ELECTRIC AUTOMOBILE COMPANY, St. Louis, Mo., has placed its first vehicle upon the streets. It is pronounced a complete success. The company expects to soon begin manufacturing on a large scale.

PITTSBURG, PA.—Director J. O. Brown, of the department of public safety of this city, has purchased an automobile fire engine from the Amoskeag Company for $9,200. The machine is to be delivered within four months.

THE ELECTRIC AUTOMOBILE COMPANY has been incorporated at Denver, Colo., for the manufacture and sale of automobiles. Capital, $3,000. Incorporators: W. H. Smith, C. S. Rodgers, W. E. Humphreys, all of Denver.

AUTOMOBILE STAGES IN NEW YORK.—The Fifth Avenue Coach Company intends to have 75 automobile stage coaches in operation on Fifth Avenue by next spring. Next month two or three large 'buses, seating 28 passengers, will be put on the avenue for experimental purposes and when they have received a fair trial the other buses will be built.

THE COSMOPOLITAN POWER COMPANY was incorporated in Jersey City a few days ago, with a $40,000,000 capital. It is a Chicago enterprise, and its officers, it is stated, will include some of the leading capitalists of that city. The corporation has been established to operate and construct all sorts of carriages driven by compressed air, electricity and gasoline. Its market will be sought mainly in the West, and it is said to be the intention of its controlling stockholders to establish close relations with the two large companies that have been organized to develop the Eastern market for automobiles. The Cosmopolitan Power Company will not make the manufacture of automobiles its whole business, but will branch out in other directions. Its factories are to be scattered through the country. W. W. Gurley, attorney, is one of the Chicago incorporators. The factory at which the carriages will be built will be located near Chicago.

THE GENERAL CARRIAGE COMPANY.—A meeting of the General Carriage Company was held in Camden, N. J., on May 3, and the following directors were re-elected: Cyrus Field Judson, Joseph Leiter, W. S. Sewell and Robert J. McKinstry. President Judson read a report which showed the company to be in a thriving condition. He stated that the earnings from the vehicles in operation have shown a daily increase, the vehicles now returning a ratio of profit never before realized in public automobile business. It is reported that the General Carriage Company has concluded negotiations with the Metropolitan Street Railway Company for the purchase of the old car stables on Sixth Avenue, between Forty-third and Forty-fourth streets, New York. The General Carriage Company, it is stated, will use part of the building for the manufacture of vehicles. While no official confirmation is obtainable, the price for the property is said to be in the neighborhood of $1,000,000.

NEW INDUSTRIAL COMPANIES.

THE HUB MOTOR COMPANY, with a capital stock of $1,500,000, has been incorporated in New Jersey. The incorporators are L. B. Dailey, E. J. Dudley and K. K. McLaren.

THE NATIONAL ELECTRIC HOSE SIGNAL COMPANY, of Boston, has been incorporated at Dover, Del., to make and sell electric hose batteries, wires and signals. Capital, $150,000.

THE ELECTRIC PNEUMATIC POWER COMPANY of New York City has been incorporated in Delaware. The object of the company is to manufacture and sell electrical appliances and devices. The capital stock is $100,000.

THE ELECTRICAL CONSTRUCTION COMPANY, of Portsmouth, Va., has been chartered. Capital, $40,000. Incorporators: P. Evans, A. H. Engetrom, M. Hellstrom, A. M. Bodine, S. B. Wheeler, all of Philadelphia, Pa.

THE MUNICIPAL SIGNAL COMPANY has been organized in Chicago to manufacture and operate electrical devices. The capital stock is $100,000, and the incorporators are Eugene Dupee, Thomas E. Milchrist and John T. Richards.

THE KEYSTONE ELECTRIC COMPANY, of Wilmington, Del., has been chartered to do business as electricians, mechanical engineers, etc. Capital, $200,000. Incorporators: R. C. Lupton, W. M. Lupton, D. T. Marvel, all of Washington.

THE NATIONAL ASSOCIATION OF ELECTRICAL ENGINEERS has been incorporated in Camden, N. J., to supply information pertaining to electrical engineering. Capital stock, $50,000. The incorporators are H. A. Salter, R. M. Eaton, F. R. Hensell.

PHOENIX, ARIZ.—Articles of incorporation of the Electric Engine & Power Company, of New York, were filed under the laws of Arizona. The capital is $60,000,000, in 6,000,000 shares, $15,000,000 being preferred stock. The corporation runs for 25 years.

THE NEW YORK DISTRICT TELEGRAPH COMPANY has been organized in New York City to conduct the messenger service. Capital stock, $5,000. The incorporators are D. W. O'Day, A. A. Kearney, Mary O'Day, all of New York City; A. W. Ransom, attorney, New York City.

THE SUN ELECTRIC COMPANY has been incorporated in Camden, N. J., with a capital stock of $1,000,000, for the purpose of manufacturing electrical appliances. The company is now negotiating for a site for its plant, in which, it is stated, between 400 to 600 men will be employed.

MACHADO & ROLLER, of Esopus, Ulster County, N. Y., have been incorporated to carry on a general business of manufacturers' agents. Directors: José A. Machado, of Plainfield, N. J.; Frank W. Roller, of Roselle, N. J.; Alfred A. Whitman, of New York City. The capital stock is $10,000.

THE COSMOPOLITAN POWER COMPANY, with an authorized capital of $40,000,000, has been incorporated at Trenton, N. J. The company will manufacture and operate engines and vehicles of all kinds. The incorporators are George E. Hargrave, Henry E. Mattison and William H. Wilson, all of Jersey City.

THE MENOMINEE ELECTRIC MANUFACTURING COMPANY, of Menominee, Mich., has been incorporated for the purpose of manufacturing electrical appliances, etc. Capital stock, $28,000. The incorporators are R. E. Jennings, H. Tideman, F. J. Dredell, Emma S. Jennings, all of Menominee. This company succeeds the Menominee Electric & Mechanical Company.

OBITUARY.

A. S. HALLIDIE, inventor of the cable railway system, died at his home in San Francisco of heart disease on April 26, at the age of 73 years. Mr. Hallidie was a native of Scotland.

CHARLES A. CHEEVER, one of the most highly esteemed members of the electrical fraternity in New York, died at his home in Far Rockaway on May 2, at the age of 48. His death came rather unexpectedly and was caused by heart trouble, resulting probably from an attack of grip. He was born in Boston on Sept. 7, 1852. Mr. Cheever made substantial progress in life in face of great physical disadvantages, being possessed of an indomitable spirit. Early in life his body became paralyzed below the waist, and his physical development was stunted in consequence. He had to be carried about in the arms of an attendant wherever he went. He was an inventor of considerable note, and had, moreover, business ability enough to gain commercial rewards from his inventions. He was particularly interested in the development of electricity, and the larger part of his career was devoted to the exploitation of electrical inventions, many of which were for improvements on the telephone. Mr. Cheever was one of the first to undertake the introduction of the telephone in New York. He organized the various sub-telephone companies in New York State, and erected and owned the first telephone line in New York City. This line ran from his own rooms to the house of Mr. E. N. Dickerson. Other lines were subsequently built by him to demonstrate the commercial value of the telephone. He was interested with Thomas A. Edison in developing the phonograph. He organized and was for several years president of the Okonite Company, and was also interested in the development of a system a few years ago for the purpose of transmitting messages from and to moving trains. Mr. Cheever was a member of the New York and Seawanhaka-Corinthian Yacht clubs. He retired from business two or three years ago and lived with his parents. He was never married.

PERSONAL.

MR. F. L. BLENDINGER has been appointed superintendent of telegraph of the Erie Railroad, in place of the late W. J. Holmes.

MR. N. MONROE HOPKINS is the subject of a biographical sketch in the May number of *The American Inventor*, Washington, D. C.

MR. A. L. CHURCH, of the Baldwin Locomotive Works, addressed the students in mechanical and electrical engineering at the University of Pennsylvania on May 26, on "Adaptability as one of the Requisites of a Successful Engineering Career."

MR. E. R. KELLER, of the firm of Keller & Pike, engineers and contractors, lectured to the mechanical and electrical engineering students of the University of Pennsylvania on May 1, on "Wiring," explaining in detail the methods used in laying out and installing electric lighting systems and their relative advantages.

MR. E. M. HAGAR, who formerly represented the Southwark Foundry & Machine Company in Chicago and later represented the C. & G. Cooper Company in the same city, is now manager of the cement department of the Illinois Steel Company. This company now has two mills, with a capacity of 2500 lbs. per day, making from blast-furnace slag a high grade of hydraulic cement well suited for use in foundations for heavy loads, such as engines, for dams and hydraulic work and for underground conduits. This material is termed "Steel Portland Cement."

F. UHLENHAUT, of New York City, has been appointed chief engineer of the Consolidated Traction Company, of Pittsburg, Pa. Mr. Uhlenhaut graduated from the Stevens Institute of Technology, and from there he went to the Thomson-Houston Electric Company. He later devoted himself to general engineering and became assistant engineer of the Philadelphia Traction Company. Subsequently he was made chief engineer of that company until he obtained the position of assistant engineer with the Metropolitan Traction Company of New York City. He left the Metropolitan Traction Company to become consulting engineer of the Telephone, Telegraph & Cable Company of New York, and from there he came to this city at the urgent solicitation of Mr. Schoepf, the general manager of the Consolidated Traction Company.

Trade Notes.

THE SIEMENS & HALSKE ELECTRIC COMPANY has removed its New York office from 320 Havemeyer Building to 40 New Street.

THE UNITED STATES MINT, at Philadelphia, is being equipped with Cross oil filters manufactured by the Burt Manufacturing Company, of Akron, Ohio.

MESSRS. F. E. MYERS & BRO., Ashland, Ohio, are equipping their factory with electric transmission. Potter & Benson, of Chicago, are the engineers.

THE MONTAUK MULTIPHASE CABLE COMPANY has removed its offices from the eighteenth to the nineteenth floor of the American Surety Building, 100 Broadway, New York City.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has issued an extremely neat and attractive fan catalogue, giving the entire line of Dayton fans, together with prices, for the season of 1900.

ELECTRICAL SUPPLIES.—Hubbard, Hall & Co., 105 East Pearl Street, Cincinnati, have issued a compact price list of electrical supplies, which differs from many such lists in that it quotes net prices.

J. A. BAILEY & CO., of Memphis, Tenn., are doing a large jobbing business in the electrical line. They have ample capital to purchase goods for cash, in large quantities and for this reason some bargains.

THE GENERAL INCANDESCENT LAMP COMPANY, 39 East Prospect Street, Cleveland, Ohio, is sending out a blotter with a celluloid top, directing attention to the fact that the company is manufacturing high-grade incandescent lamps.

THE EASTERN ELECTRICAL CONSTRUCTION COMPANY, of Philadelphia, has removed its offices from 658 Bourse Building to 112 North Broad Street, Fidelity Mutual Life Building. Mr. W. D. Barnard is general manager of the company.

THE O. C. WHITE COMPANY, of Worcester, Mass., has recently equipped the law library and reading rooms of the Worcester County court house with its standard portable fixtures. Seventy-five sets of portable desk fixtures with extra fine finish were bought by the county.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has established an agency with the W. R. Garton Company, 315 Dearborn Street, Chicago, Ill. A large stock of all sizes of Moloney transformers will be kept in stock, thus assuring prompt shipment on all orders.

THE TRUMBULL MANUFACTURING COMPANY, of Warren, Ohio, whose plant was recently destroyed by fire, has about decided to erect a new plant at Warren. The company has recently accepted a contract to go into the manufacture of automobiles for a Chicago concern.

THE FALCON ELECTRIC MANUFACTURING COMPANY, of New York, is contemplating the enlargement of its business by the addition of an enclosed arc lamp to the lines of motors, switches, etc., already carried. Satisfactory progress is reported and an efficient lamp may be expected on the market next fall.

MR. CURTIS J. HARRINGTON has been appointed manager of the sales department of the General Equipment Company, manufacturer of magnetic circuit-breakers, 117 Federal Street, Camden, N. J. Mr. Harrington was formerly connected with the Morris Electric Company, of New York, in charge of its New England territory.

THE GUTMANN WATTMETER for alternating currents is one of the strong lines of the Electric Appliance Company, of Chicago, who are the general sales agents for the meter. In this connection it is advertising that selling calico without a yard-stick or sugar without scales is akin to the practice of selling current without a wattmeter.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, reports a good demand for the "Buckeye" incandescent lamp. The special cellulose filament used in this lamp finds much favor with central station managers because of the long-maintained candle-power and brilliant illumination. The Western trade is served promptly from Chicago stock.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is manufacturing a graphite brush for motors and dynamos, which, it informs us, exceeds anything it has been able to buy, both in economy and efficiency. They have been tested by others and found satisfactory. The company will be glad to hear from any one interested in this line.

THE PITTSBURG REDUCTION COMPANY has removed its eastern sales office from the Havemeyer Building to the sixth floor of the Phelps-Dodge Building, corner Cliff and John streets, New York City. Mr. Charles W. Hall will no longer attend to the company's local New York business. The company will itself handle all local New York business, and carry in New York a small stock of standard sizes and grades of aluminum ingots, sheets and wire. Mr. S. K. Colby, eastern agent, whose headquarters will be in the Phelps-Dodge Building, will assume charge of the local New York business in addition to the general eastern business.

THE CHICAGO BELTING COMPANY reports that it has doubled its business in the last six months, and that its direct sales for the last six days of April amounted in all to $18,008.31. This showing is conclusive of the fact that notwithstanding the keenest competition, there is a growing demand for its products. This increased business has made it necessary to increase its capital stock to $100,000, all paid in.

ERICSSON TELEPHONES.—L. M. Ericsson & Co., of Sweden, a few years ago established an American branch, the Ericsson Telephone Company, 296 Broadway, New York. Since then the business has rapidly increased, and to-day they are selling telephones all over the United States. The Ericsson Company has recently been obliged to increase the size of its office and stockroom to meet the growing demand.

HAKE'S COMMUTATOR COMPOUND.—Messrs. Southworth & Hare, Indianapolis, Ind., report that they are receiving large orders from Mr. F. C. Ross, their Eastern agent, at 255 Greenwich Street, New York. In the opinion of the firm this indicates that the electrical people of New York appreciate the merits of the compound. Free samples may be obtained by applying to any of the firm's agents or to the factory at Indianapolis.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, is issuing a folder showing illustrations of its direct-current desk and ceiling-fan motors. Twelve-inch and 16-in. fans are shown for desks and brackets with and without swivel, and there are also illustrations of open and enclosed field types. One of the striking illustrations is that showing the entire fan motor taken apart by the removal of only two bolts. Of the ceiling fan illustrations are shown two and four blades with and without electroller.

NEW POWER HOUSE.—The new boiler and power house for the Albany & Hudson Railway & Power Company will be located at Stuyvesant Falls, N. Y., and will be a fireproof construction throughout. It will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn. The Berlin Company has also received the contract for 13 important bridges on the N. Y., N. H. & H. R. R. Ten of these are large, heavy, four-track bridges, and three of them are to carry highways over the tracks. All of the work is to be completed by Oct. 1.

THE ECCLESTON LUMBER COMPANY, 29 Broadway, New York, has recently opened a new distribution yard in Twenty-fifth Street, South Brooklyn, with railroad and water facilities for shipping anywhere any quantity of goods on demand. This new departure will be welcomed as a great convenience to the trade as the principal trouble heretofore has been the delay in filling orders in all branches of lumber business. The above company carries in stock at this yard about 15,000 yellow pine cross-arms of all Standard sizes.

INDEPENDENT TELEPHONE ESCUTCHEON.—The Maltese cross having become identified with the independent telephone movement, the Eureka Electric Company, of Chicago, has incorporated it into a neat design for the stationery of independent companies, and will be pleased to send gratis an electrotype to any company applying for the same, accompanied by a lapel button bearing the same design. The Eureka Company is at work upon a central energy system, which it will have ready for the market within the next 60 days, which will contain several important improvements over anything ever shown.

MR. ROBERT L. McOUAT, of Indianapolis, Ind., has just purchased the interest of Mr. Gordon E. Varney in the firm of Varney & McOuat, and will continue the business at the present location, 125 South Meridian Street. In addition to their wholesale electrical supply business, they are manufacturing telephones, telephone switchboards, leather nail heads, pins, brackets and cross-arms. From the central location, unequaled railroad facilities, large and complete stock, ample shipping force, they are in a position to make prompt deliveries.

THE LOWELL MODEL COMPANY, of Lowell, Mass., has recently doubled its facilities, having built an addition to the factory and added a number of new machines, and is now prepared on a much larger scale than before to accommodate customers. The company builds gasoline motors of all kinds, for stationary, marine and automobile purposes. It is also placing on the market a neat and compact motor for bicycles. Orders are also filled for castings of all sizes for gasoline motor purposes, and, in addition, general experimental and model work is done.

STEPHENSON'S BAR BELT DRESSING.—An interesting case of curing a slipping belt is reported by the Stephenson Manufacturing Company, Albany, N. Y. Mr. E. A. Kellogg, the manager of the company, applied one of the company's 2-oz sample sticks of belt dressing to a 30-in. belt, 18 ft. between centres, and in two minutes afterward the indicator showed an increase in speed of 42 revolutions. This is an example of the results that may be obtained by the judicious use of a first-class article. This was a case where a little went a good way.

INDUSTRIAL APPLICATION OF ELECTRICITY.—The latest production of the General Electric press is a beautifully executed 48-page pamphlet, entitled "Industrial Applications of Electricity." A considerable portion of the matter relates to power distribution in workshops, with illustrations showing many applications to tools. Another portion deals with cranes and tramways and still others with transfers and turntables, printing machinery, pumps and hoists and various special factory applications. The pamphlet is, in fact, a well-written, descriptive treatise on the various subjects treated rather than of the character of the usual trade publication.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, owing to recent largely increased demands for air-brake and steam hose, has erected an additional story, 235 x 45 ft., to its hose room. It has also built a new two-story building, 42 x 54 ft. for the "Peerless" line of packings. As the factory has been run night and day for the past ten months, turning out Rainbow packing, etc., the company will soon be compelled to make other additions to its buildings, already the largest in the rubber trade, to keep up to the demand for its goods.

THE PRINDLE PUMP COMPANY.—A petition in involuntary bankruptcy was filed on May 4 against the Prindle Pump Company, of 120 Liberty Street, New York, by the following creditors: Sprague Electric Company, $690; Wagner Electric Manufacturing Company, $167; the Cutler-Hammer Manufacturing Company, $65. It was alleged that on April 24 the company, while insolvent, permitted the General Electric Company to obtain a preference by judgment under which the sheriff made a levy upon property of the company valued at $1,000, which was advertised for sale on May 7.

THE INTERSTATE ELECTRIC COMPANY, of Cleveland, Ohio, has been recently incorporated for the purpose of manufacturing arc lamps for all circuits. It will in a short time have a 500-volt incandescent arc on the market that can be connected direct in multiple to a 500-volt circuit independently of any other lamps, giving a perfect arc, with intense brilliancy, at a consumption of from 450 to 500 watts; from which there is no great loss in the consumption of current. The company claims that the efficiency is as high as that of the ordinary 110-volt arc lamp. This lamp will induce suburban lines to contract for arc lighting in towns through which they pass.

THE MACHINISTS' STRIKE IN CLEVELAND has not seriously affected the screw machinery business of the Cleveland Machine Screw Company, because the company had a large stock of finished machines on hand. Work in the automobile department, however, has been delayed considerably. The automobile exhibit for the Paris Exposition was under way at the time the strike went into effect, but by hard work with a few hands it was completed and shipped a few days ago. The machinists employed by the company held a meeting and 70 of them have since returned to work. The factory, which had been closed entirely, was started up and about 125 men are at present at work.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that it is in a position to make prompt shipments from New York City of all regular desk, bracket and ceiling fans of its manufacture. It has largely increased its manufacturing facilities for the more rapid production of its goods. Three carloads of desk and ceiling fans have already been forwarded to the company's New York warehouse and additional carloads will be forwarded from time to time as occasion demands. All correspondence and orders sent to the Emerson branch office at 136 Liberty Street, New York City, will receive the same prompt and careful attention as if addressed to the home office in St. Louis.

LARGE NEW CATALOGUE.—The new catalogue of the Western Electrical Supply Company, of St. Louis, has nearly 1100 pages and embraces everything pertaining to electricity. It is divided into departments, each department illustrating fully a complete line of the most representative goods. The catalogue covers direct and alternating generators and motors, arc lamps, lighting supplies of every description, street railway supplies, house goods and telephone supplies —in fact, "everything electrical." Being exclusive territorial agent for a number of the largest and best known manufacturers, among whom are John A. Roebling's Sons Company, Ohio Brass Company, Indiana Rubber & Insulated Wire Company, Adams-Bagnall Electric Company, the Emerson Electric Manufacturing Company, Ansonia Electric Company, Warren Electric Manufacturing Company, Eddy Electric Manufacturing Company, etc., its success is natural. The company states it is in a position to equip complete central stations, street railways, telephone lines and exchanges. In fact, it is prepared to furnish from stock "everything electrical" in all that the term implies.

BERLIN OYSTER ROAST.—On the evening of April 28 the Berlin Iron Bridge Company, of East Berlin, Conn., gave an oyster roast to its employees and families and friends of the company. Twenty-seven thousand invitations were sent out. About six thousand of those invited responded, coming from all parts of the country. Men prominent in political and commercial life were present. The employees of the company were given a general holiday and enjoyed themselves throughout the day and evening by various pastimes. At 6 o'clock trains from all directions began to pour in with immense crowds. The works, decorated with bunting, were thrown open to the guests, and huge tables were arranged inside, on which were piled roasted oysters in abundance. While the guests were regaling themselves, a band, made up of the employees of the works, played popular pieces. One of the buildings was fitted up as a dancing hall, where the young people enjoyed themselves until the last train pulled out of East Berlin at 11 o'clock. The company is to be congratulated on its liberal policy toward its employees, customers and friends on these annual occasions.

THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION.—The growth of this school has been so rapid that the old quarters at 120 Liberty Street, New York, some time ago became inadequate to meet the demands for space. The institute has, therefore, been compelled to seek larger quarters, and has now removed to 240-242 West Twenty-third Street, New York. The rapid progress and success of the institute is particularly due to its president, Mr. Joseph Wetzler, M.E., E.E., so favorably known throughout the electrical profession. As a correspondence institute, the Electrical Engineer Institute enjoys a high reputation, and, as is well known, the text-books supplied by the institute are prepared by the best practical experts in the country; furthermore, the students study under the personal supervision of competent electrical engineers. For this reason the institute claims that it can impart to any one able to read and write, the best practical electrical information obtainable. The institute teaches also mechanical engineering, mechanical drawing, etc. The institute has now enrolled a large number of students, located not alone all over the United States, but in nearly every foreign civilized country on the globe. Tuition charges are based either on the cash plan or on the basis of monthly instalments, optional with the student.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 1, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

648,378. SYSTEM OF ELECTRICAL DISTRIBUTION; O. Behrend, Frankfort-on-Main, Germany. App. filed Dec. 28, 1897. (See Current News and Notes.)

648,388. VOLTAGE REGULATOR; W. H. Chapman, Portland, Me. App. filed Feb. 23, 1900. A relay responding to delicate currents throws into circuit either of two solenoids, which in turn control a rheostat. The solenoids are interwound with a closed circuit to absorb the self-induced current produced when the circuit through them is broken.

648,432. RAILWAY SIGNAL; S. C. Prentiss, Detroit, Mich. App. filed June 10, 1898. The invention consists of the details of construction of a circuit-closing device.

648,439. PROCESS OF PRODUCING ALLOYS OF IRON AND TITANIUM; A. J. Rossi, New York. App. filed June 20, 1899.

648,446. ELECTROMAGNETIC COIL; R. Varley, Jersey City, N. J. App. filed Dec. 18, 1899. To give support to the terminal of a magnet coil, a section of stranded wire is secured to the terminal, and the joint is sustained by a loop of insulating material, which is cemented to the outer surface of the coil.

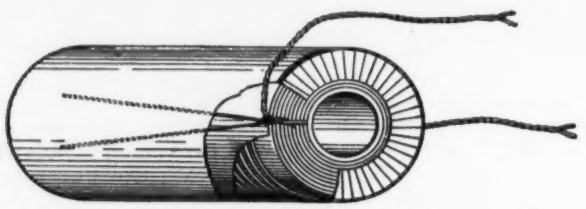
648,463. PROCESS OF ABSTRACTING SILICON FROM SILICIOUS MATERIALS; R. I. Knaur, Vienna, Austria-Hungary; H. W. Buck, Schenectady, N. Y., and C. B. Jacobs, East Orange, N. J. App. filed April 1, 1898. (See Current News and Notes.)

648,481. ELECTRICAL RESISTANCE; A. W. Berresford, Westfield, N. J. App. filed Nov. 9, 1899. The resistance is built up of a number of cast metal grids, so separated from metallic contact by insulating pieces as to permit free access of air to the surface of the grids.

648,487. ELECTRIC CLOCK; W. J. Dudley, Somerville, Mass. App. filed Jan. 30, 1899. An improvement in the details of construction of the clock described in patent No. 447,105.

648,489. SYSTEM OF DISTRIBUTION; W. L. R. Emmet, Schenectady, N. Y. App. filed March 10, 1899. (See Current News and Notes.)

648,492. THERMOELECTRIC GENERATOR; J. W. Harrison, Pueblo, Colo. App. filed Sept. 1, 1896. A body having a heated area, consisting of a series of electrically connected vessels containing stored heat and a heat generator, flexible conductors of electricity connected with separate parts of said body, and a shell composed of different metals having a cold area, and a diaphragm extending from one inner side portion to the other over the said cold area, and in direct electrical connection with said conductors.



648,446.—Electromagnetic Coil.

648,493. REGULATING DYNAMO ELECTRIC MACHINES; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 27, 1899. (See Current News and Notes.)

648,494. REGULATING DYNAMO ELECTRIC MACHINES; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 27, 1899. (See Current News and Notes.)

648,501. APPARATUS FOR SUPPORTING OVERGROUND WIRES; C. J. Kronenberg, Aufderhohe, Germany. App. filed Oct. 12, 1899. This is a metal cross-arm for poles, provided with a slight bend in the middle to receive the pole and having openings in it, letting the wind through.

648,516. ELECTRIC LAMP WITH BURNER OF THE SECOND CLASS; Karl Ochs, of Berlin, Germany. App. filed June 29, 1899. The enclosing globe is provided with apertures, through the lower one of which a burning match or taper or lamp-flame may be introduced to heat the electrolytic conductor in order to reduce its resistance.

648,517. ELECTRICAL GLOW LAMP WITH ILLUMINATING BODY OF SECOND-CLASS MATTER; Karl Ochs, of Berlin, Germany. App. filed Sept. 16, 1899. In proximity to the electrolytic conductor is a heating conductor; the lamp socket switch contains an electromagnet which cuts out the heating conductor when current passes through the electrolytic conductor.

648,526. EMERGENCY CIRCUIT CLOSER; A. J. Purinton, Waterbury, Conn. App. filed July 20, 1899. A piston normally exposed to the working steam pressure, moves to close a circuit, when the pressure is suddenly relieved, the circuit then operating an electromagnet is cut off.

648,529. DYNAMO-ELECTRIC MACHINE; E. W. Robinson, of Schenectady, N. Y. App. filed Oct. 8, 1898. In an electric railway motor, a single bolt serves to clamp the bearings in place, and to hold together the two halves of the frame.

648,533. CONNECTION COUNTER FOR TELEPHONE LINE; C. E. Scribner, Chicago, Ill. App. filed Jan. 7, 1899. The improved counter comprises an actuating magnet for operating the counting mechanism and a controlling magnet for preventing the operation of the actuating magnet, the operating and controlling magnets being associated with the line in circuit whereby the controlling magnet is normally excited, and a switch at the central office for controlling the magnets independently to render the controlling magnet inert and the actuating magnet operative.

648,543. ELECTRICAL ATTACHMENT FOR HYDROCARBON OR OTHER BURNERS; F. Wilke, Akron, Ohio. App. filed June 10, 1899. This is a thermostat located near to a hydrocarbon burner to close an alarm circuit in case the flame is blown out accidentally.

648,546. ELECTRICAL MEASURING INSTRUMENT; J. F. Begole, St. Louis, Mo. App. filed Sept. 28, 1899. The instrument is provided with a rotating indicator, a coil traversed by the current to be measured and inclined to the axis of the indicator and an armature carried by the indicator, the same inclination being maintained between the coil and armature throughout the travel of the armature. The object is to make the turning force uniform for all points in the traverse.

648,555. ELECTRIC SWITCH; W. Ely, Providence, R. I. App. filed Feb. 19, 1897. Details of construction.

648,625. ELECTRIC ARC LAMP; H. V. James, Salford, England. App. filed Oct. 10, 1899. Details of construction.

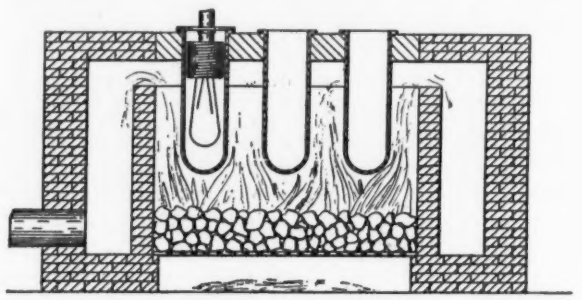
648,647. LATCH DROP DEVICE FOR TELEPHONE SWITCHBOARDS; E. E. Yahley and C. C. Cadden, Chicago, Ill. App. filed Sept. 15, 1899. The magnet is placed in a shield independent of the armature and may be removed for repairs without interfering with the armature.

648,655. APPARATUS FOR REMOVING DEPOSIT OF CARBON FROM INCANDESCENT ELECTRIC LIGHT BULBS; E. W. Cushion, Middleton, Mass. App. filed Nov. 29, 1899. The lamp is placed in a retort, and the heat thus applied to it by radiation instead of by direct flame.

648,660. X-RAY APPARATUS; R. A. Fessenden, Allegheny, Pa. App. filed Aug. 7, 1899. (See Current News and Notes.)

648,671. SWITCH FOR ELECTRIC CIRCUIT; J. T. Robb, New York, N. Y. App. filed Dec. 21, 1899. This is a chandelier switch, by the turning of which one or more lamps may be thrown into circuit.

648,673. ELECTRIC APPARATUS FOR SURGEONS' USE; H. Schlesinger, New York, N. Y. App. filed Nov. 28, 1899. This is a box containing a battery, flexible conducting cords extending therefrom to small lamps or other instruments and spring drums upon which the cords are wound to take up slack.



648,655.—Apparatus for Removing Deposit of Carbon from Incandescent Electric Light Bulbs.

648,677. ADVERTISING DEVICE; F. Alcock, London, England. App. filed July 7, 1899. Several groups of electric incandescent lamps so arranged on several circuits as to form or illuminate the outline of a design or figure, or portions thereof, in different attitudes, some of said groups being common to two or more attitudes, with switching mechanism by the operation of which the group of lamps on one circuit are switched off simultaneously or nearly simultaneously, with the switching on of the circuit of the succeeding group of lamps, thereby making the design or figure appear to assume different attitudes.

648,696. METHOD OF CONTROLLING ELECTRIC MOTORS; M. T. A. Kubierschky, Berlin, Germany. App. filed Dec. 6, 1899. (See Current News and Notes.)

648,710. FUSE BLOCK; G. C. Quelch, Vintondale, Pa. App. filed Oct. 10, 1899. Details of construction.

648,731. APPARATUS FOR ELECTRICALLY LIGHTING LAMPS; H. C. Farquharson, New York, N. Y. App. filed Sept. 5, 1899. The invention consists in the details of the device for supporting the block of insulating material which sustains the two electric terminals at a position near the lamp wick.

648,764. APPARATUS FOR PRODUCING OZONE BY ELECTRICITY; J. H. Lamprey, London, England. App. filed Dec. 7, 1899. (See Current News and Notes.)

648,834. TROLLEY; C. H. Bierbaum, Buffalo, N. Y. App. filed Jan. 20, 1900. The side flanges and thread of the wheel are held by casting the hub around them.

648,850. ELECTRIC LINE CUT-OUT; C. A. Clark, Hartford, Conn. App. filed June 28, 1898. Details of construction.

648,874. BOOSTER APPARATUS FOR SYSTEMS OF ELECTRICAL DISTRIBUTION; L. Lyndon, New York, N. Y. App. filed Nov. 22, 1899. (See Current News and Notes.)

648,892. ELECTRICAL RESISTANCE; J. F. Bachmann and A. Vogt, Vienna, Austria-Hungary. App. filed Dec. 19, 1899. (See Current News and Notes.)

648,895. INDICATOR FOR TELEPHONE; C. F. Black, Goshen, Ind. App. filed Nov. 15, 1899. Details of construction.